Oceanographic Observations from the Bay of Fundy for the Pre-operational Environmental Monitoring Program for the Point Lepreau, N.B. Nuclear Generating Station.

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Rapport statistique canadien sur l'hydrographie et les sciences océaniques

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En général, les rapports contiennent des données brutes ou analysées mais ne fournissent pas d'interprétations des données. Ces compilations sont préparées le plus souvent à l'appui de travaux reliés aux programmes et intérêts du service des Sciences et Levés océaniques (SLO) du ministère des Pêches et des Océans.

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Les établissements des Sciences et Levés océaniques dans les régions et à l'administration centrale ont cessé de publier leurs diverses séries de rapports depuis décembre 1981. Vous trouverez dans l'index des publications du volume 38 du *Journal canadien des sciences halieutiques et aquatiques*, la liste de ces publications ainsi que le dernier numéro paru dans chaque catégorie. La nouvelle série a commencé avec la publication du Rapport n° 1 en janvier 1982.

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OCEANOGRAPHIC OBSERVATIONS FROM THE BAY OF FUNDY FOR THE PRE-OPERATIONAL ENVIRONMENTAL MONITORING PROGRAM FOR THE POINT LEPREAU, N.B. NUCLEAR GENERATING STATION

by

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ABSTRACT

Bugden, G.L. Oceanographic observations from the Bay of Fundy for the pre-operational environmental monitoring program for the Point Lepreau, N.B. nuclear generating station. Can. Data Rep. Hydrogr. Ocean Sci. 27: iv + 40 p.

A monitoring program has been established within the Department of Fisheries and Oceans, Bishop et al. (1980), to assess the environmental impact of the Point Lepreau Nuclear Generating Station, the first of its type to be placed on the Canadian coastline. As part of the pre-operational monitoring activities, a series of four oceanographic cruises to the area were undertaken spanning 1979 through 1981. The physical oceanographic data collected during these cruises, consisting of temperature-salinity profiles, current meter observations from a moored ship and ocean drifter releases are graphically presented.

RÉSUMÉ

Bugden, G.L. Oceanographic observations from the Bay of Fundy for the pre-operational environmental monitoring program for the Point Lepreau, N.B. nuclear generating station. Can. Data Rep. Hydrogr. Ocean Sci. 27: iv + 40 p.

Bishop et al. (1980) du ministère des Pêches et Océans ont élaboré un programme de surveillance visant à déterminer les effets sur l'environnement de la sttion nucléaire de Pointe Lepreau, la première station du genre qui ait été aménagée sur la côte canadienne. Dans la cadre du programme, on a effectué quatre croisières océanographiques s'échelonnant de 1979 à 1981. Les données obtenues à la faveur de ces croisières - profils température-salinité et informations courantométriques recueillies par un navire amarré et un dériveur - sont présentées sous forme de graphiques.

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1.0 INTRODUCTION

To meet the objectives of the Point Lepreau Environmental Monitoring Program, Bishop et al. (1980), a series of oceanographic cruises to the Bay of Fundy were undertaken. During these cruises, the water column was sampled for temperature, salinity, nutrients, suspended matter, trace metals and various radionuclides. Bottom sediments were also collected. As much as possible, the same stations were occupied on each cruise, additional stations being added as required. On each cruise an anchor station near the Point Lepreau cooling water outfall was occupied for approximately two tidal cycles. During the occupation of this station regular temperature-salinity casts were conducted. In addition, current meters were suspended from the anchored ship and surface and bottom drifters released periodically. In this report, the temperature-salinity, current meter and drifter data are presented. Other data collected are described elsewhere, Smith et al. (1981).

The following table gives relevant information about the cruises, instruments and operations.

Cruise number and date	CTD	Current Meters	Drifters
79-007 May 1-6 1979	9 stations + anchor station	-	-
79-027 October 24-28 1979	35 stations + anchor station	5 m at anchor station	-
80-018 June 9-14 1980	43 stations + anchor station	5 m and 40 m at anchor station	62 surface and 72 bottom at anchor station
81-010 April 14-21 1981	48 stations + anchor station	5 m and 35 m at anchor station	28 surface and bottom at anchor station

CTD data is presented as selected sections, time series contour plots for the anchor stations as well as near surface contour maps. Current meter data is presented as rate and direction as well as temperature and salinity time series. Drifter data are presented as charts showing locations of returned drifters.

2.0 Cruise 79-007

The stations occupied during this cruise are shown in Figure 1. Limited geographical coverage was obtained during this cruise relative to subsequent cruises. No current meter data were collected and as drifters were being released at this time as part of a larger drifter program, Bugden (1980) no drifters were released.

2.1 CTD Data

As station coverage was limited no vertical or horizontal temperature-salinity sections are presented. Figure 2 shows time series contour plots of temperature and salinity from the anchor station indicated as station 10 in Figure 1. Casts were made at the rate of one each hour.

3.0 Cruise 79-027

The stations occupied during this cruise are shown in Figure 3. Geographical coverage was much more extensive for this cruise, a total of 36 stations including the anchor station being occupied. Drifters were not released during this cruise, but current meter data was obtained from the anchored ship at station 36.

3.1 CTD Data

A series of 6 vertical sections, indicated A-F on Figure 3 were prepared and are presented in Figures 4-8. Horizontal sections of temperature and salinity at a depth of 5 m are presented in Figure 9 and time series contour plots of temperature and salinity at the anchor station (station 36) are shown in Figure 10.

3.2 Current Meter Data

Current velocity, temperature and salinity observations were obtained by suspending a current meter at a depth of 5 metres from the anchored ship at station 36. The data are displayed in Figure 11. An additional instrument suspended at a depth of 35 metres failed with no data return.

The presence of the large metal mass of the ship's hull near the magnetic compass of the 5 metre instrument would be expected to introduce some error, but as the wind was very calm during the observation period, comparison of the ship's heading at anchor with the current meter measurements was possible. These comparisons indicated that the ships hull produced deviation of about 17°W on the instrument compass at a depth of 5 m when the current was southwesterly and perhaps an equivalent amount of easterly deviation when the current was northeasterly.

A vertical profile was performed with the instrument near the beginning of day 301 (October 28). The current directions observed were consistent with the 18°W deviation from the ship's hull extending to about 20 m, with a constant actual current direction. The rate was constant in the upper 5 m at 84 cm/s, decreasing in a linear fashion to about 35 cm/s at a depth of 30 m. The average current during the observation period was 33.7

cm/s in a direction of 223°T when corrected for the deviation caused by the ship's hull. Note that the current directions presented in Figure 11 have not been corrected for this error.

4.0 Cruise 80-018

The stations occupied during this cruise are shown in Figure 12. Surface and bottom drifters were released and current meter observations obtained at the anchor station (station 49).

4.1 CTD Data

Six vertical sections A-F equivalent to those from cruise 79-027 are presented in Figures 13-17. Equivalent horizontal sections and time series contour plots are presented in Figures 18 and 19 respectively.

4.2 Current Meter Data

During the occupation of the anchor station, station 49, current meter observations were obtained at depths of 5 and 40 metres. The data are presented in Figures 20 and 21. The same caution indicated for the 5 m current directions from Cruise 79-027 applies, although comparison with the ship's head was not possible and thus compass error was not quantified. The effect of the ship's hull would not be expected to extend to the lower instrument.

4.3 Drifter Data

During the occupation of the anchor station (49), surface and bottom ocean drifters were released at the rate of two of each per hour. The details of drifter construction, etc. have been described elsewhere,

Bugden (1980). The recovery positions of returned drifters are shown in Figures 22 and 23. The release times of returned drifters are also shown on the appropriate current meter data plots, Figures 20 and 21.

A total of 62 drifters of each type were released. 14.5% of the surface drifters released were recovered, all from the Maces Bay area. The average time between release and recovery was 33 days, ranging from 4 to 106 days.

9.7% of the bottom drifters released were recovered with an average time between release and recovery of 302 days, ranging from 151 to 489 days. Most were recovered late in 1980 or in the early months of 1981.

5.0 Cruise 81-010

The stations occupied during this cruise are indicated in Figure 24. Surface and bottom drifters were released and current meter observations obtained at the anchor station.

5.1 CTD Data

The six vertical sections A-F, equivalent to those from previous cruises are presented in Figures 25-29. Equivalent horizontal sections and time series contour plots are presented in Figures 30 and 31 respectively.

5.2 Current Meter Data

Current meter observations were again obtained at 5 m and 35 m during the occupation of the anchor station (49-77). Unfortunately, the rate from the 5 m instrument was faulty due to an instrument malfunction. The data are shown in Figures 32 and 33. The same caution as was expressed regarding the direction from the 5 m instrument applies here.

5.3 Drifter Data

Again during the occupation of the anchor station, surface and bottom drifters were released, this time at a rate of 1 of each per hour. The recovery positions of returned drifters are indicated in Figures 34 and 35 and release times for these drifters are shown in Figures 32 and 33. One surface drifter was recovered beyond the boundaries of Figure 34, approximately 56 km further down the United States east coast.

28 drifters of each type were released. 10.7% of the surface drifters were recovered with an average time between release and recovery of 166 days, ranging from 79 to 215 days. 7.1% of the bottom drifters were recovered.

6.0 Bibliography

Bishop, F.J., Ellis, K., Smith, J.N. and Bewers, J.M. 1980. Pre-operational Environmental Monitoring Report for the Point Lepreau, N.B. Nuclear Generating Station Bedford Institute of Oceanography, Report Series BI-R-80-1, 36 pp.

Bugden, G.L. 1980. Point Lepreau Environmental Monitoring Ocean Drifter Release Program Bedford Institute of Oceanography Report Sries BI-R-80-4

Smith, J.N., Ellis, K. and F.J. Bishop. 1981. Pre-operational Environmental Monitoring Report for the Point Lepreau, N.B. Nuclear Generating Station, 1980, Bedford Institute of Oceanography, Report Series BI-R-81-10, 194 pp.

MacLaren Marex Inc. 1979. Review of the Physical Oceanography of the Bay of Fundy for the Point Lepreau Environmental Monitoring Program, Department of Fisheries and Oceans Report.

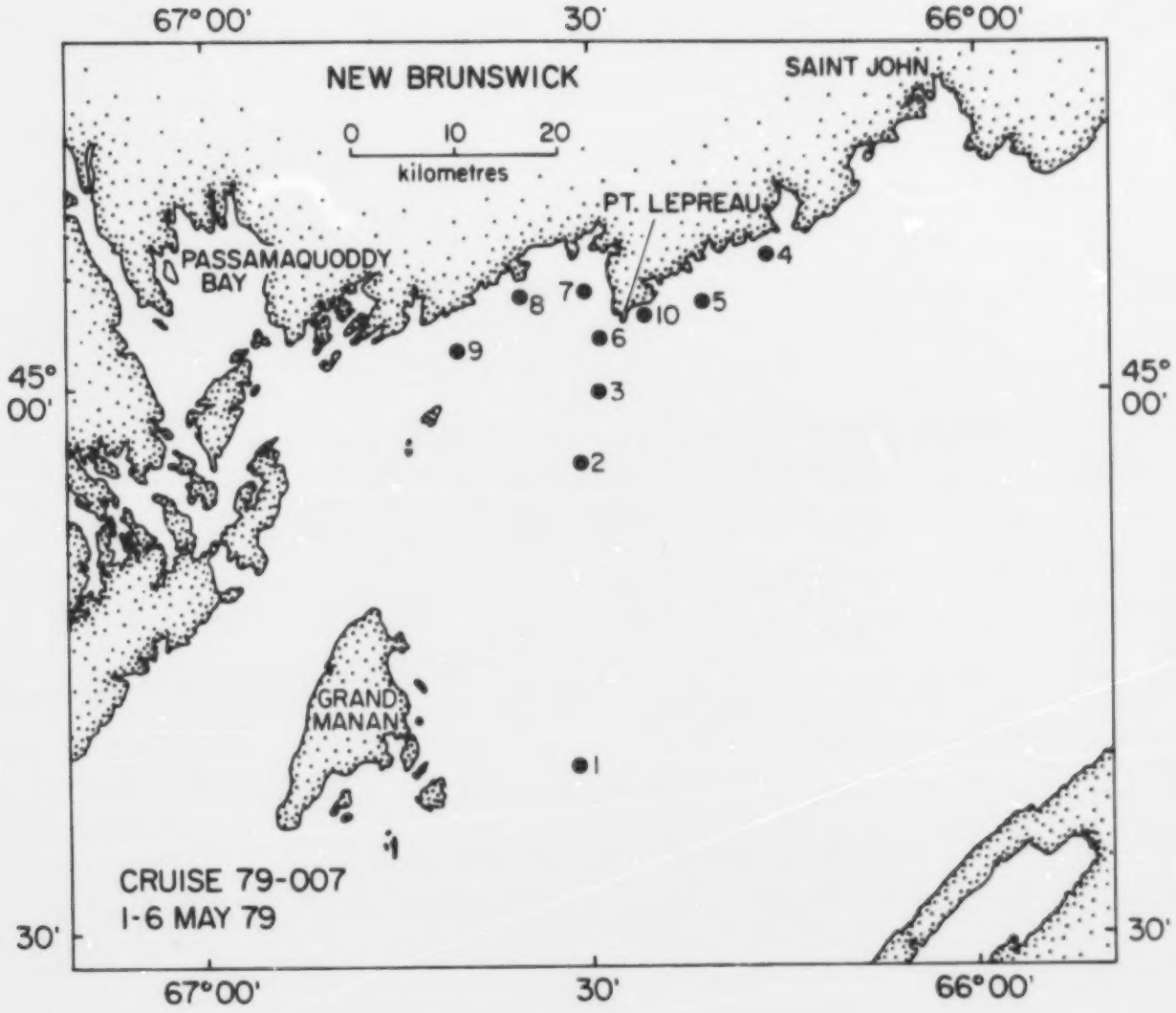

Figure 1

Stations occupied during cruise 79-007.

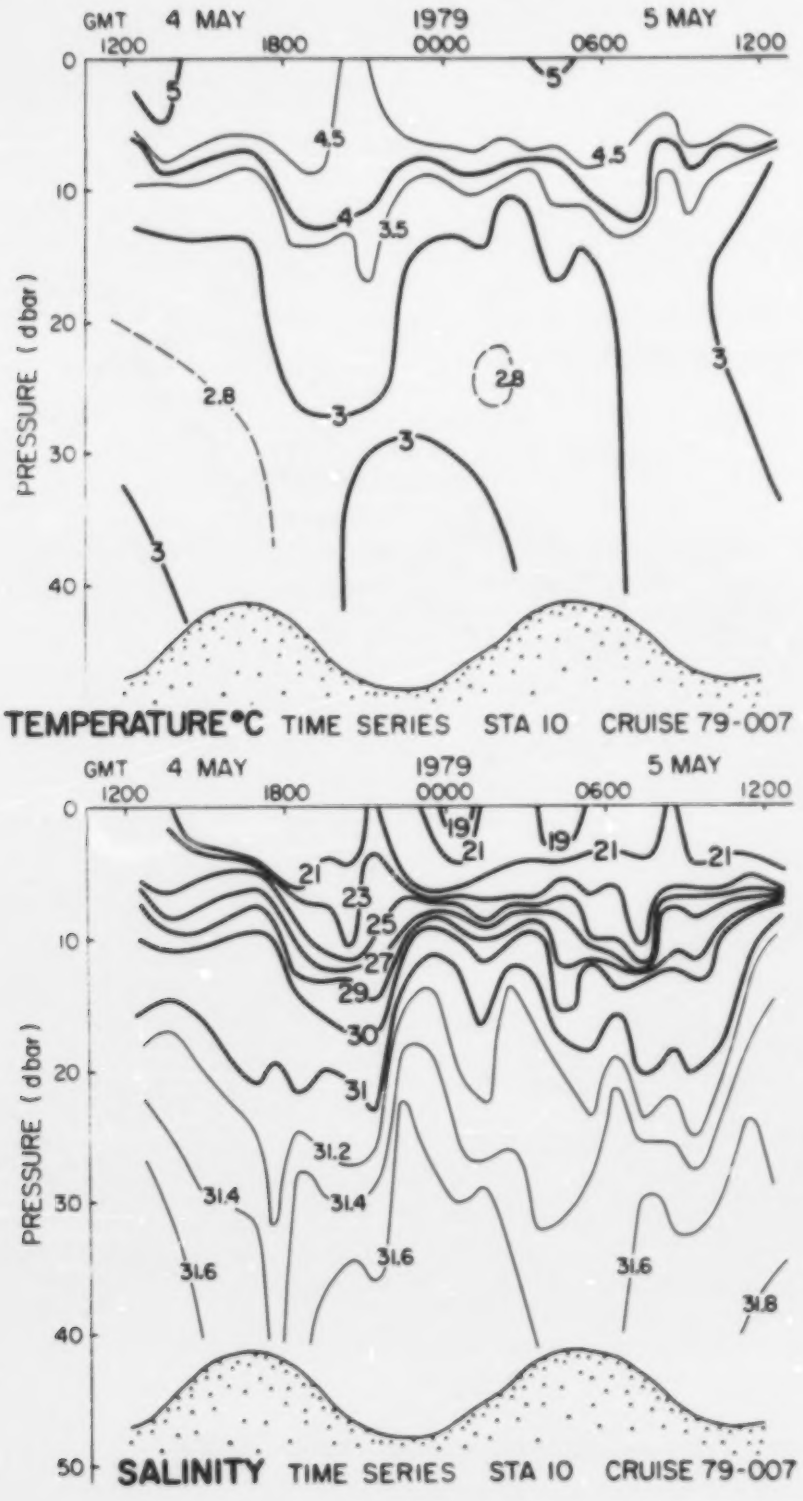
GMT 4 MAY 1979 5 MAY
1200 1800 0000 0600 1200
PRESSURE (dbar)
TEMPERATURE °C TIME SERIES STA 10 CRUISE 79-007
SALINITY TIME SERIES STA 10 CRUISE 79-007

Figure 2

Time series contour plots of temperature and salinity from the anchor station (station 10) near the cooling water outfall cruise 79-007.

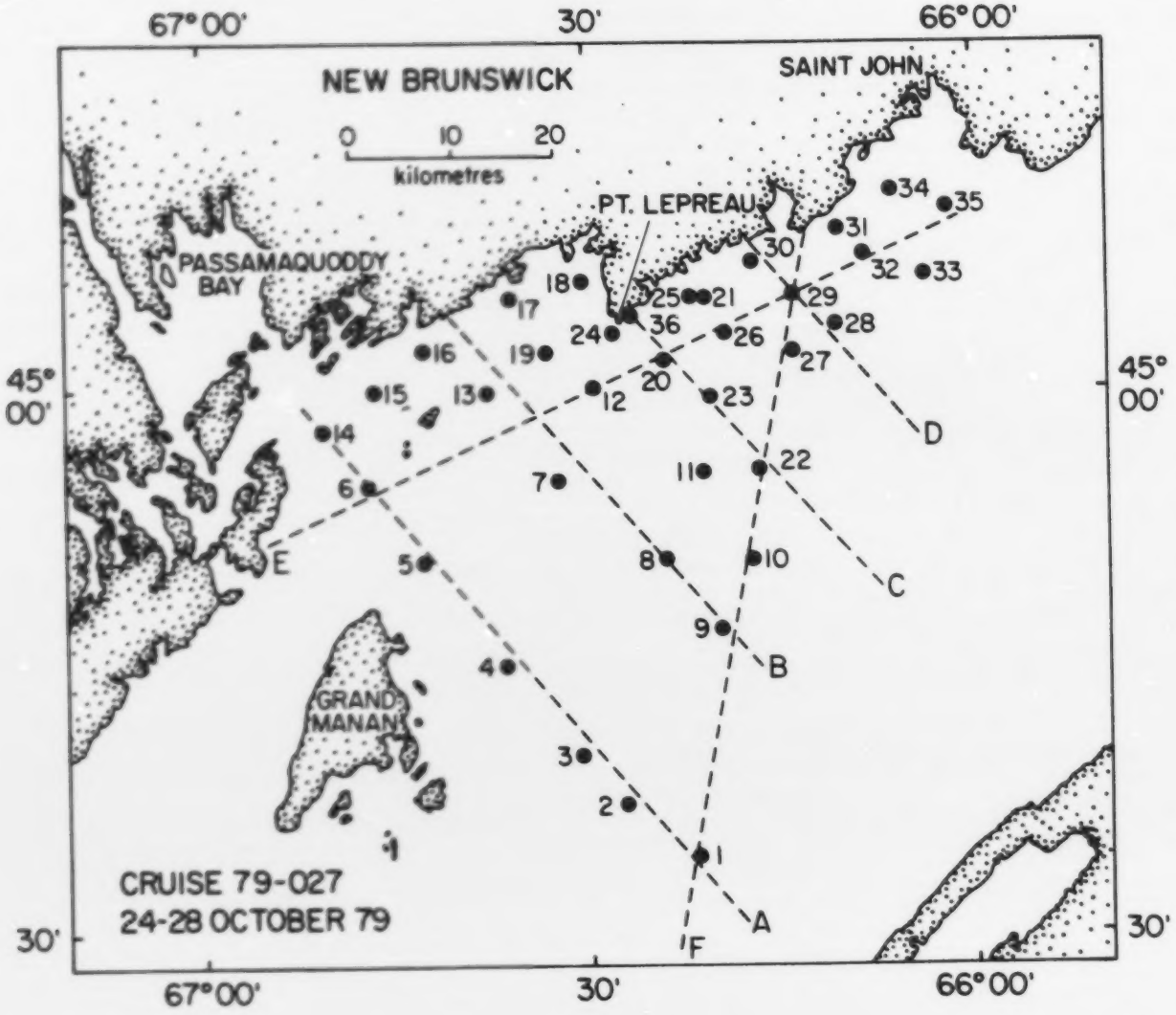

Figure 3

Stations occupied during cruise 79-027 showing locations of vertical sections.

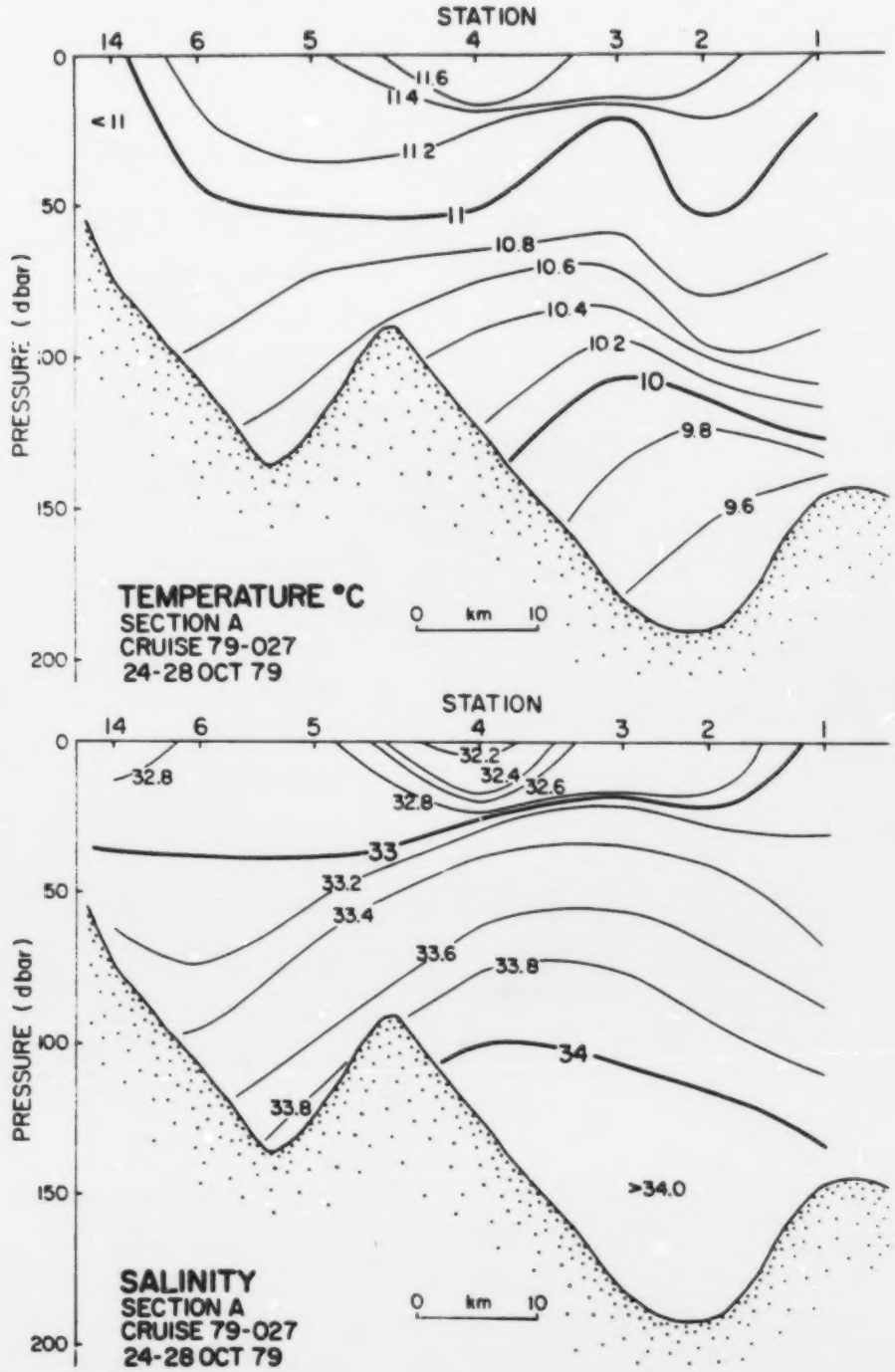

Figure 4

Vertical sections of temperature and salinity for section A cruise 79-027.

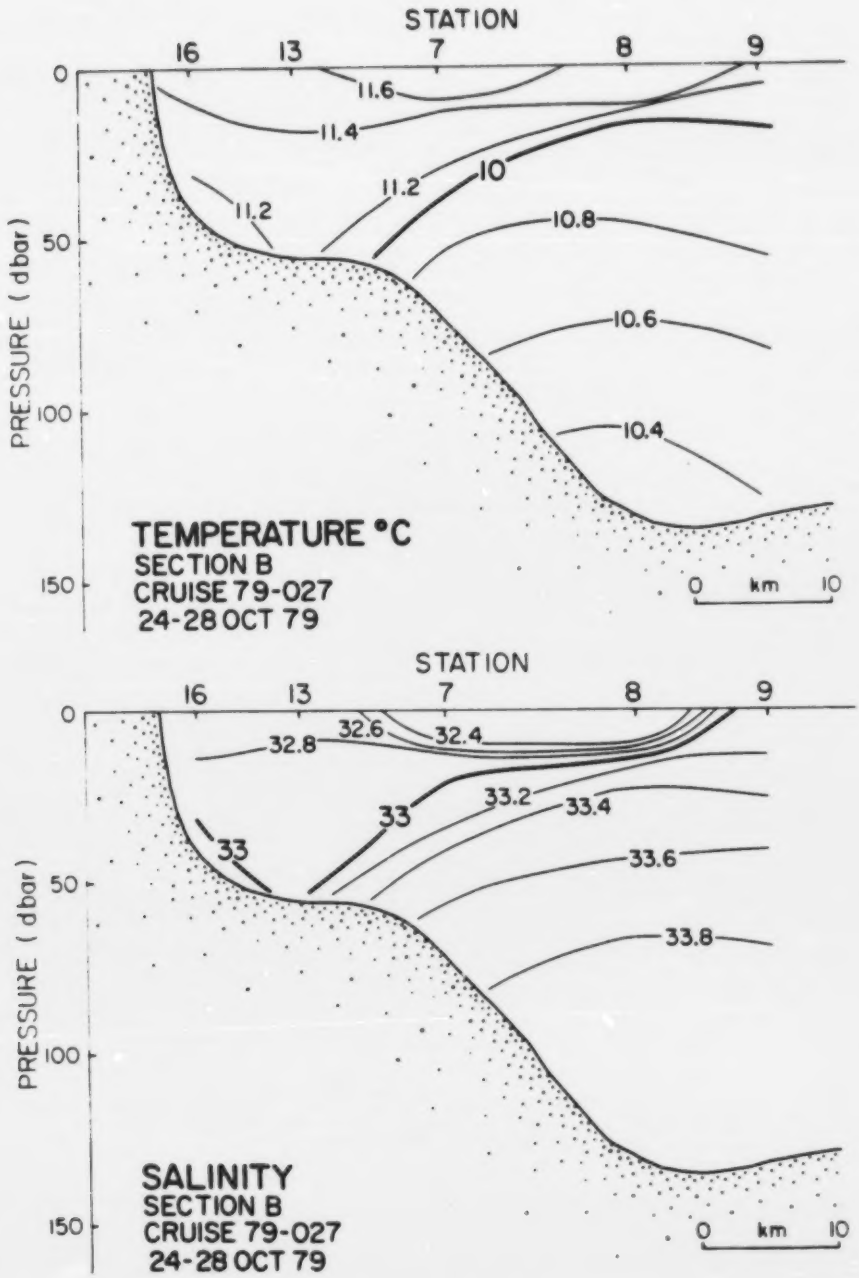

Figure 5

Vertical sections of temperature and salinity for section B cruise 79-027.

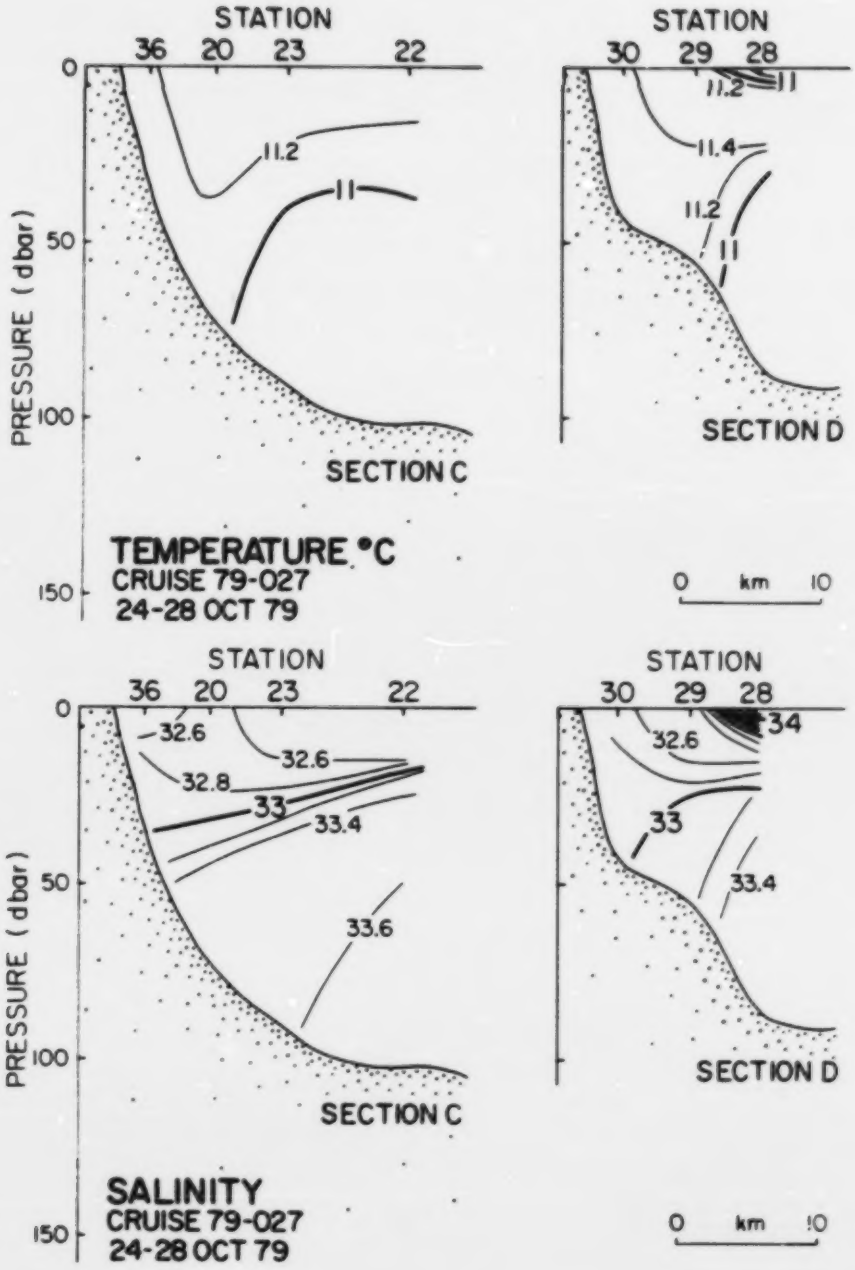

Figure 6

Vertical sections of temperature and salinity for sections C and D cruise 79-027.

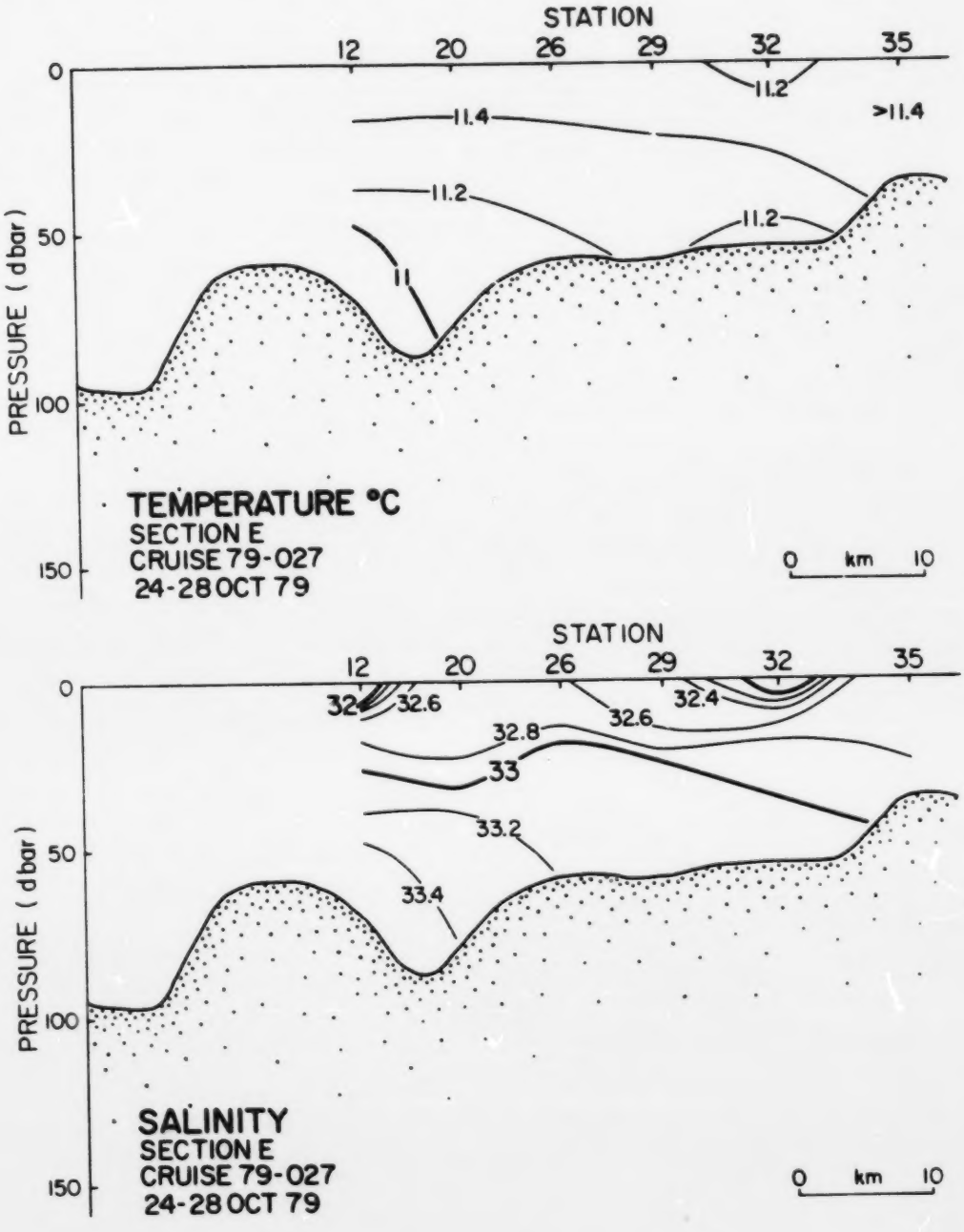

Figure 7

Vertical sections of temperature and salinity for section E cruise 79-027.

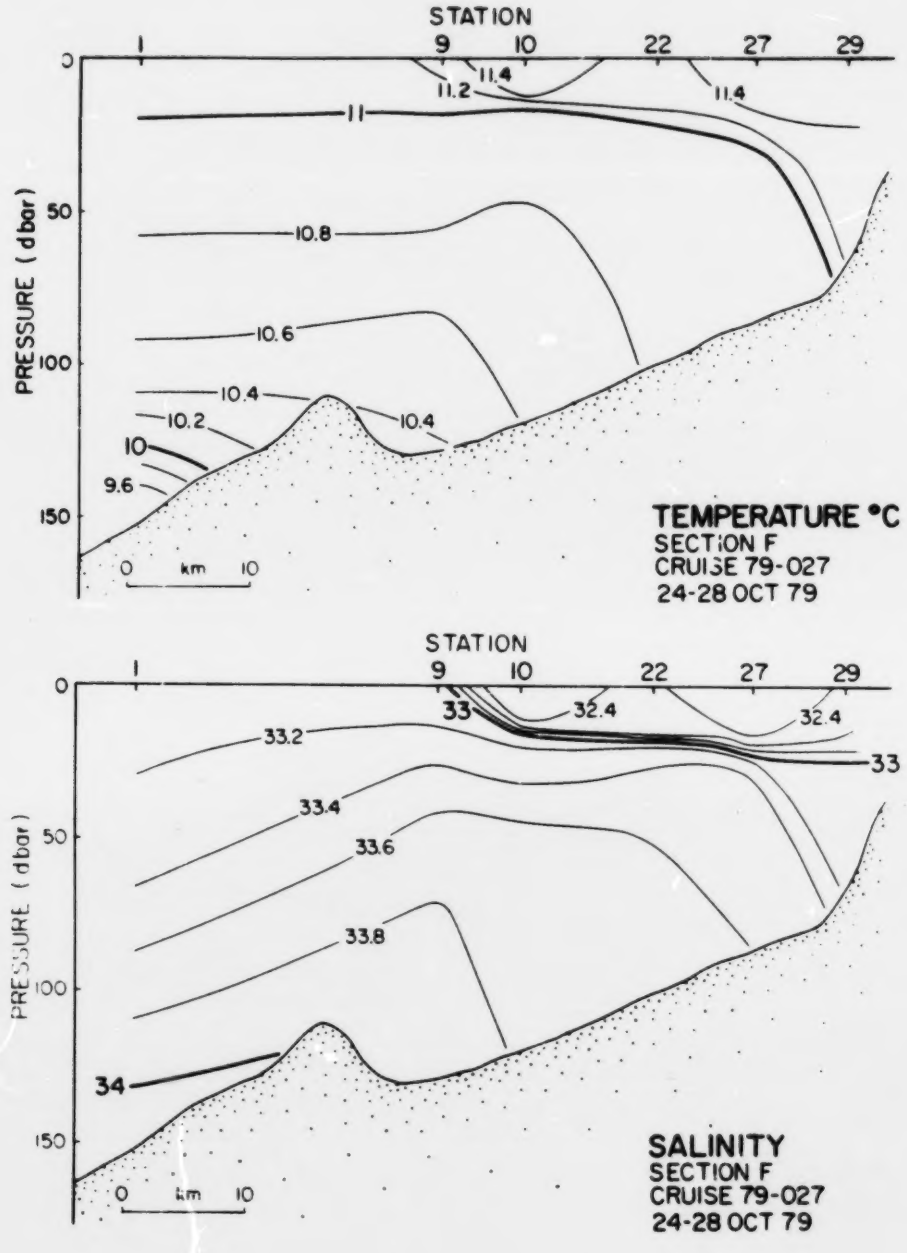

Figure 8

Vertical sections of temperature and salinity for section F cruise 79-027.

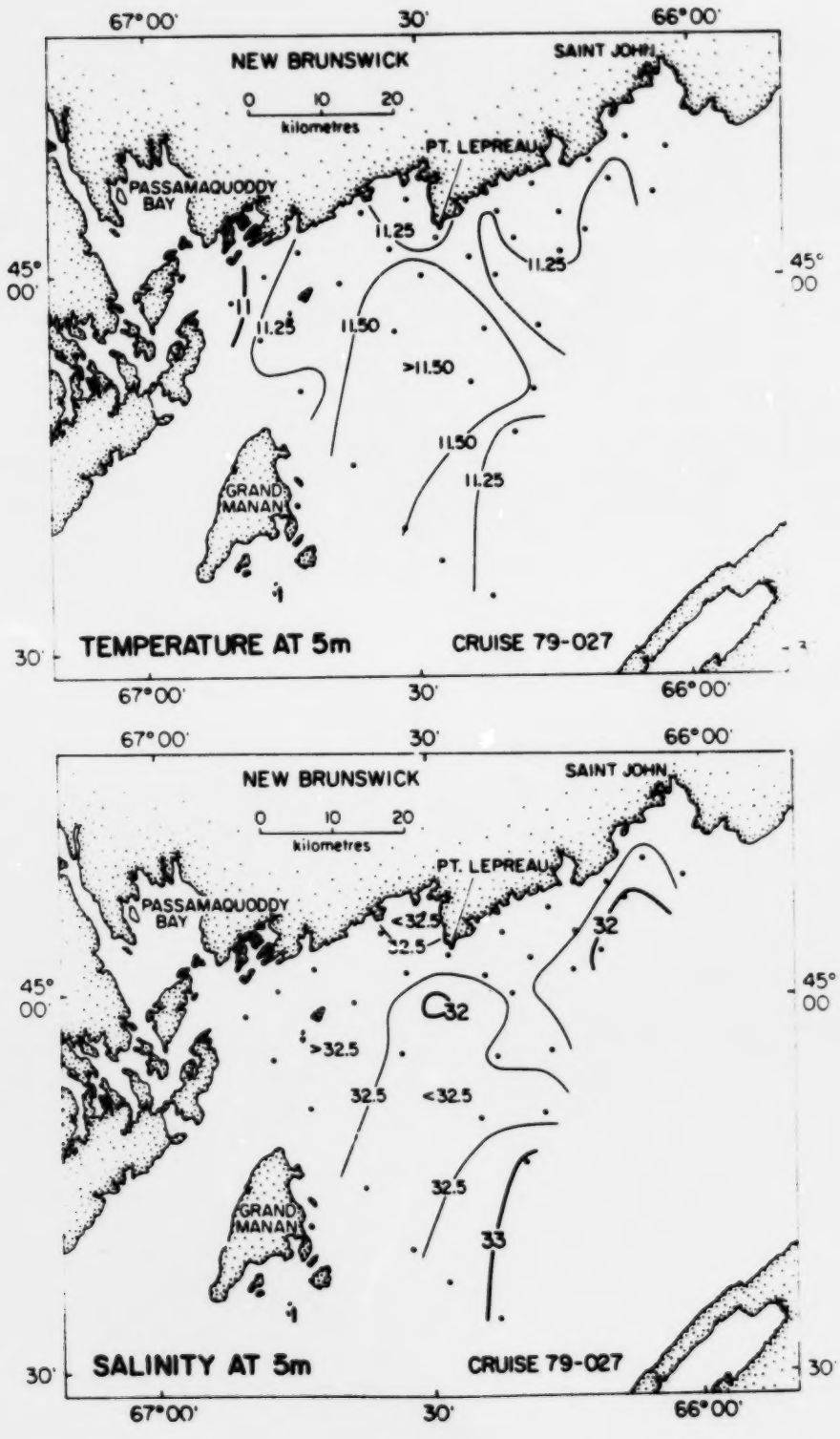

Figure 9

Horizontal sections of temperature and salinity at a depth of 5 m cruise 79-027.

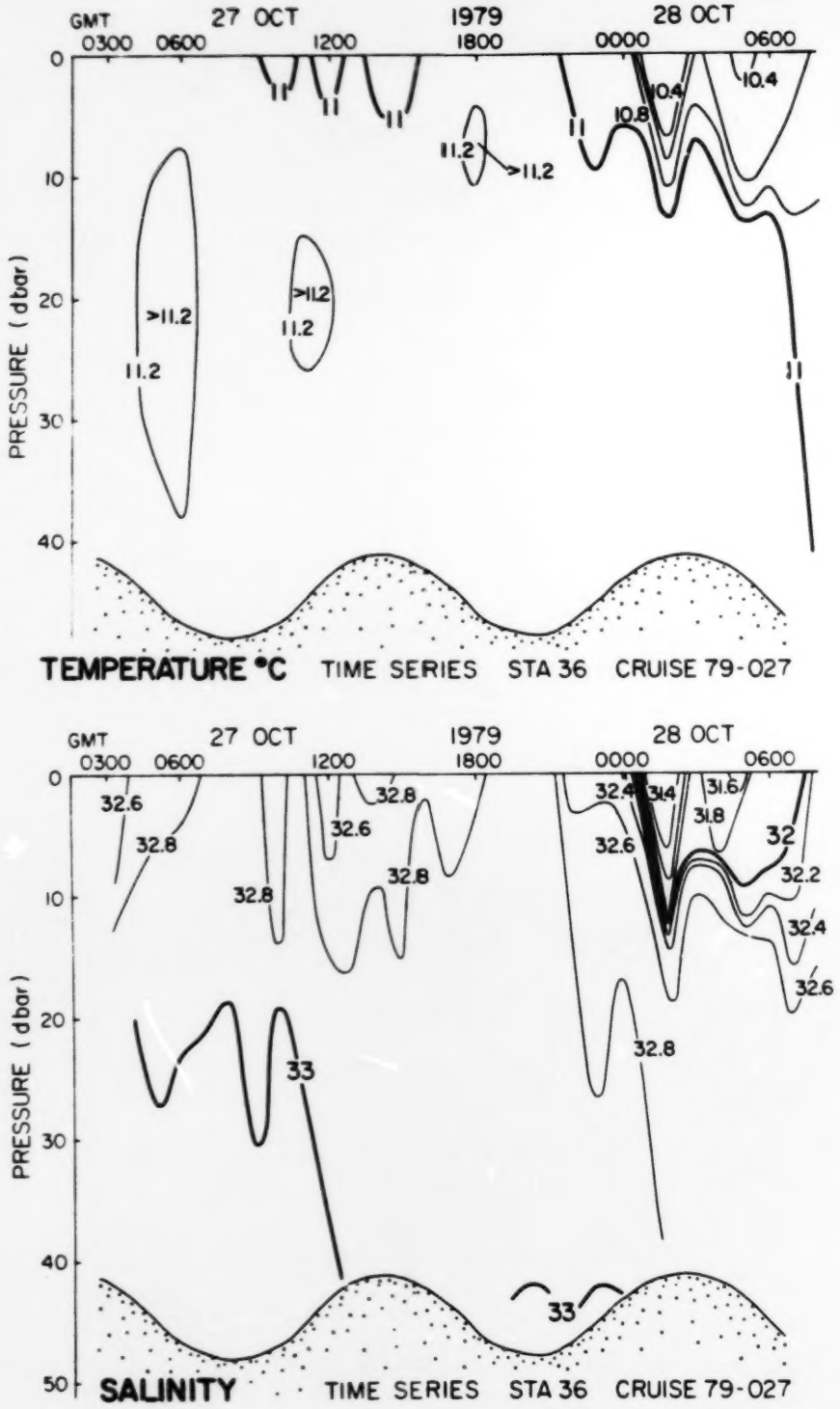

Figure 10

Time series contour plots of temperature and salinity from the anchor station (station 36) near the cooling water outfall cruise 79-027.

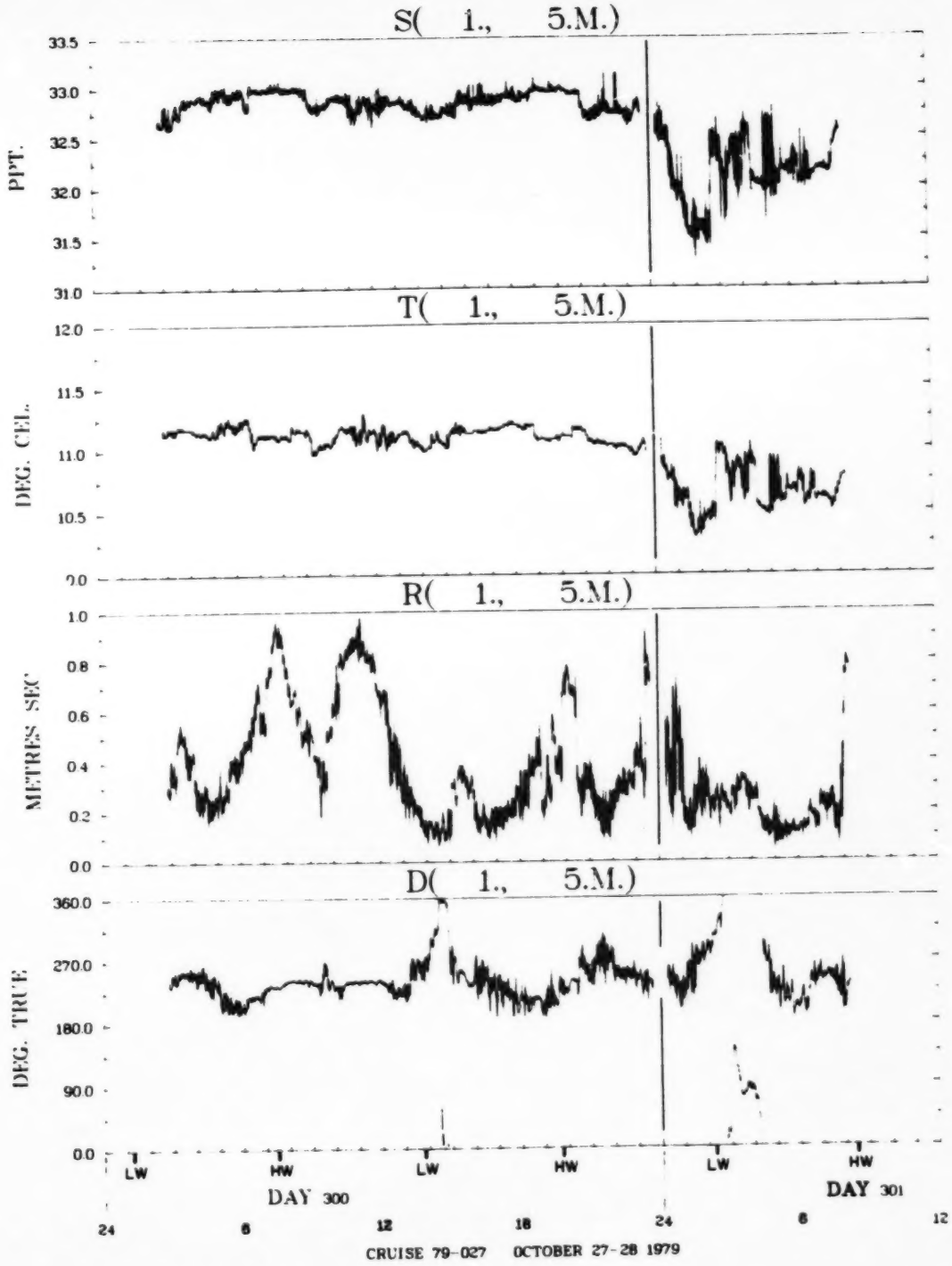

Figure 11

Current meter observations at station 36 cruise 79-027 showing times of high and low water at St. John. See text for explanation of possible errors in current direction.

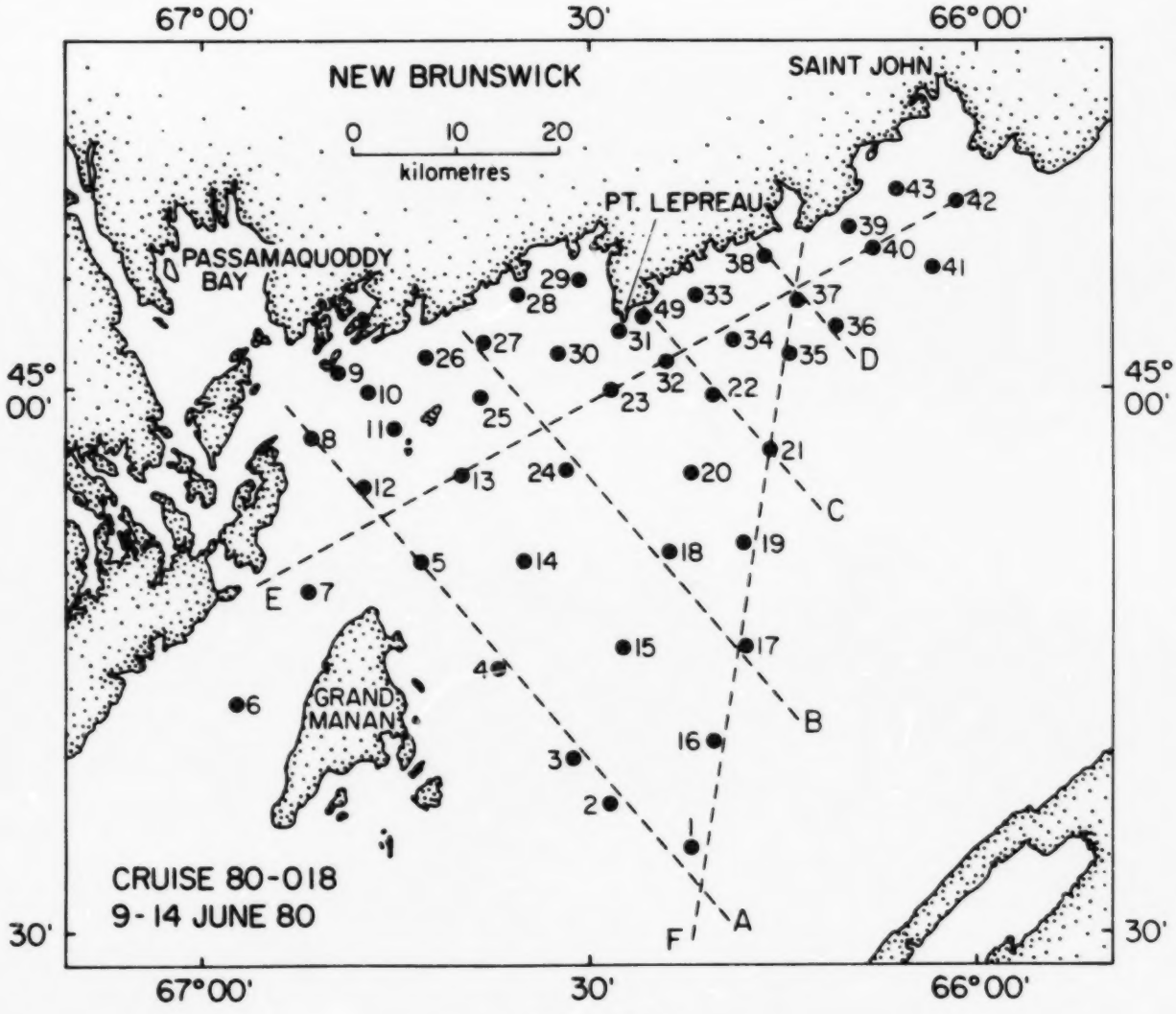

Figure 12

Stations occupied during cruise 80-018 showing locations of vertical sections.

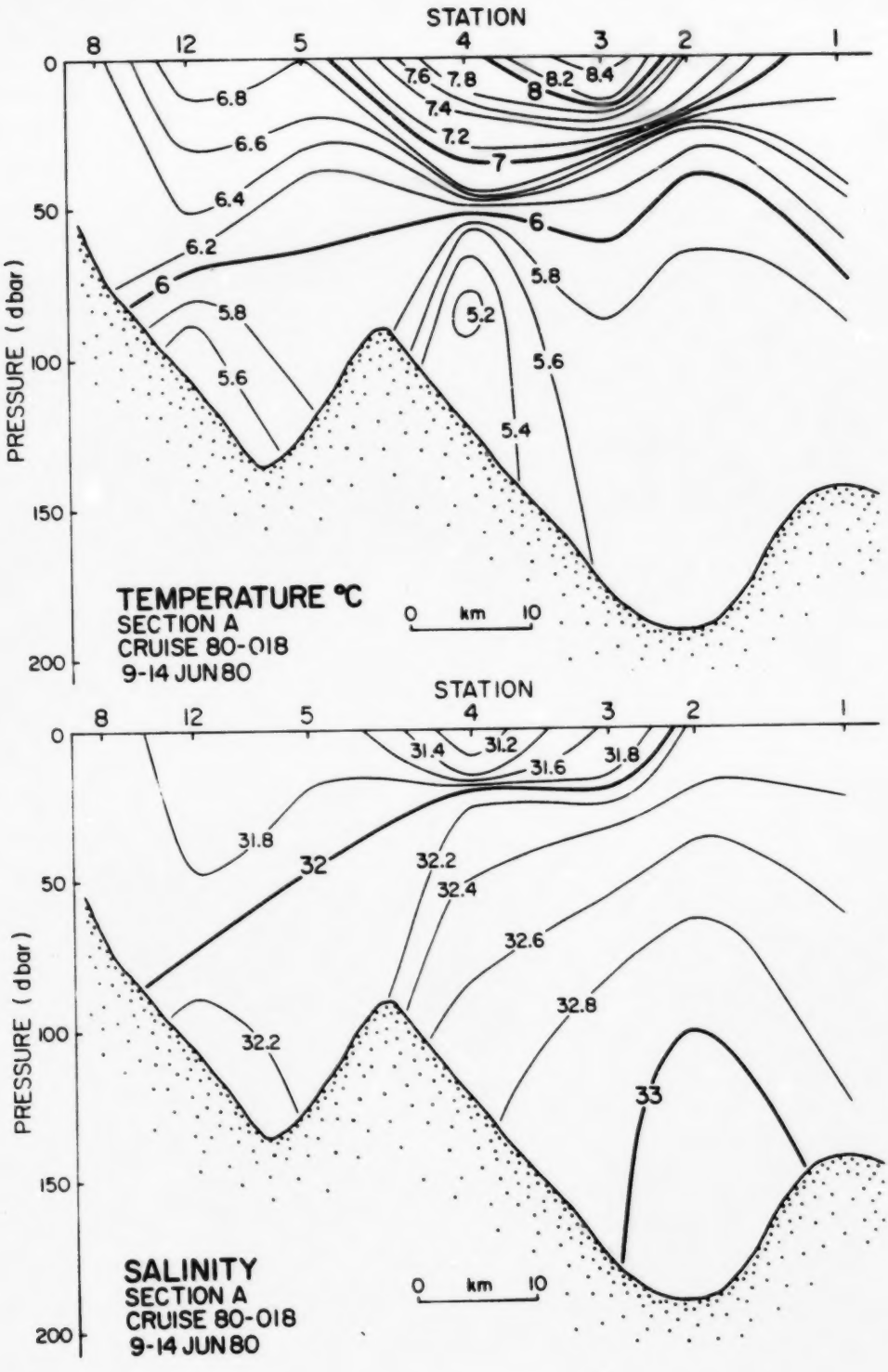

Figure 13

Vertical sections of temperature and salinity for section A cruise 80-018.

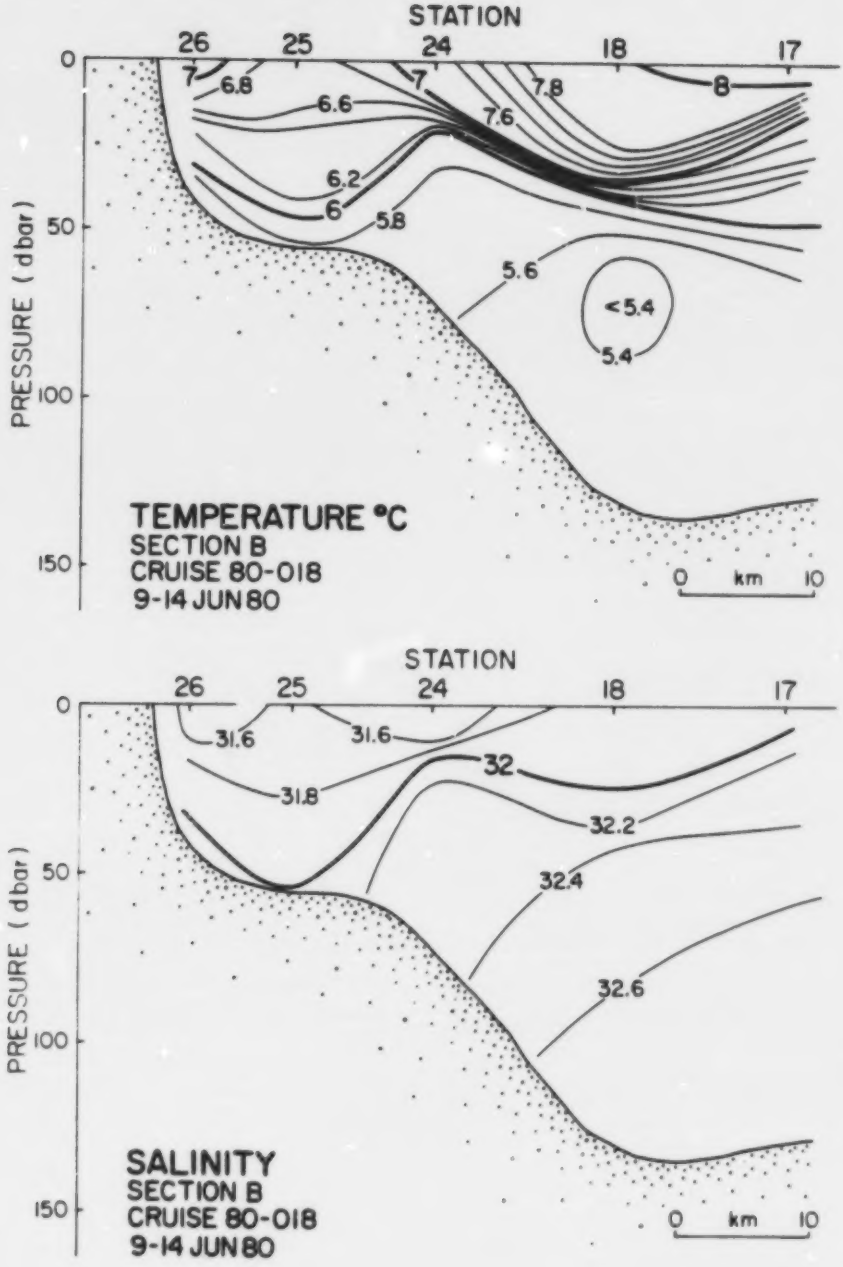

Figure 14

Vertical sections of temperature and salinity for section B cruise 80-018.

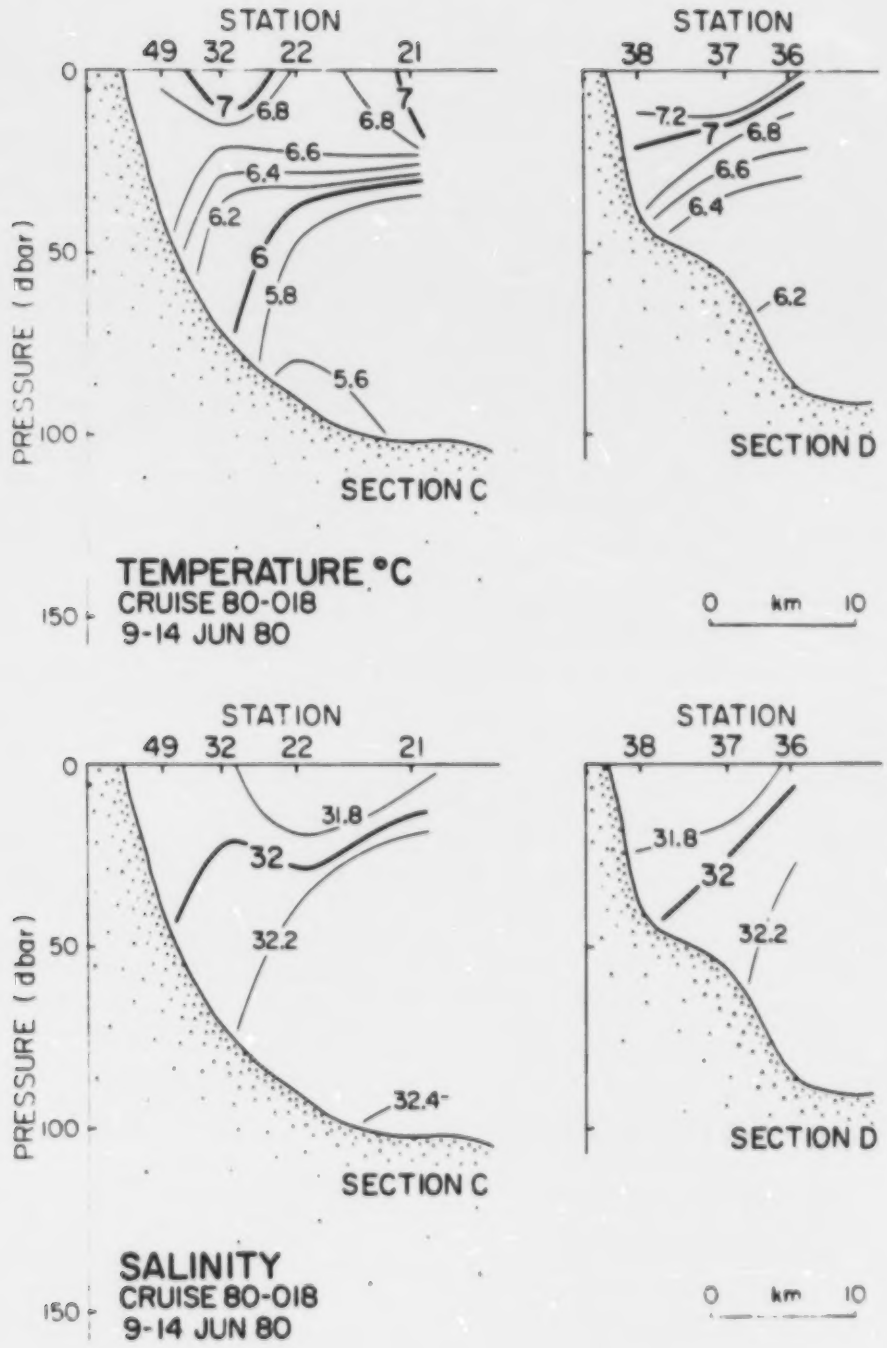

Figure 15

Vertical sections of temperature and salinity for sections C and D cruise 80-018.

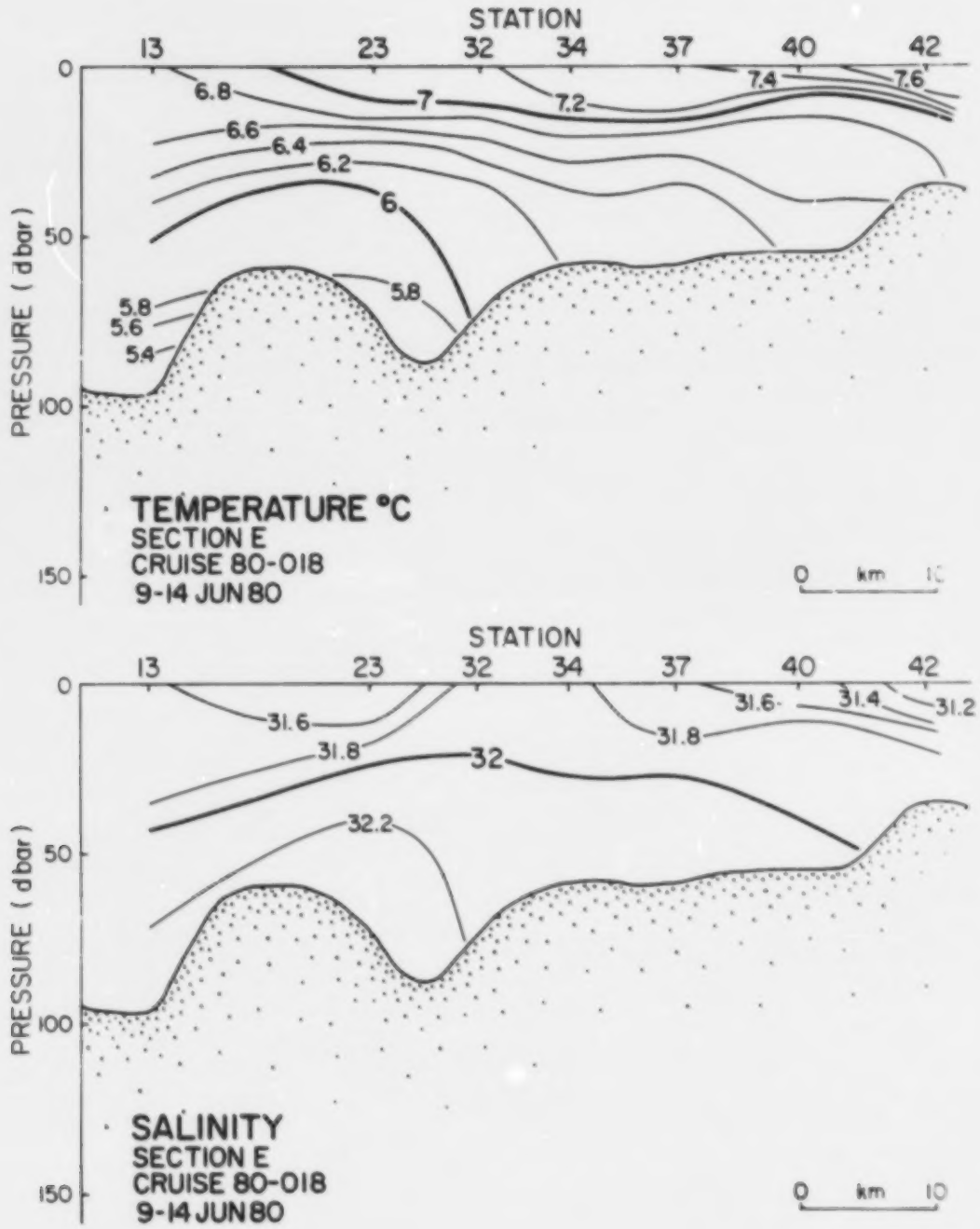

Figure 16

Vertical sections of temperature and salinity for section E cruise 80-018.

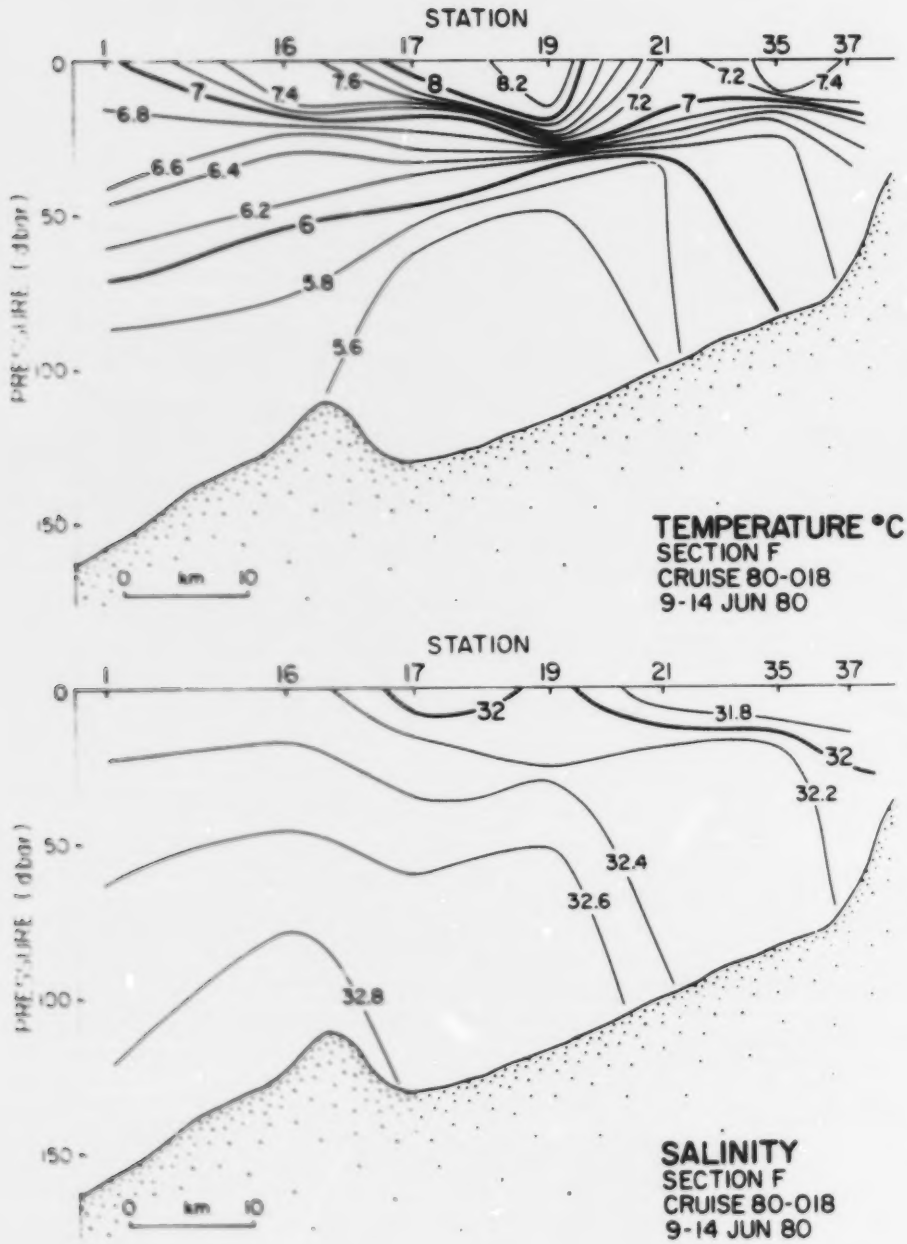

Figure 17

Vertical sections of temperature and salinity for section F cruise 80-018.

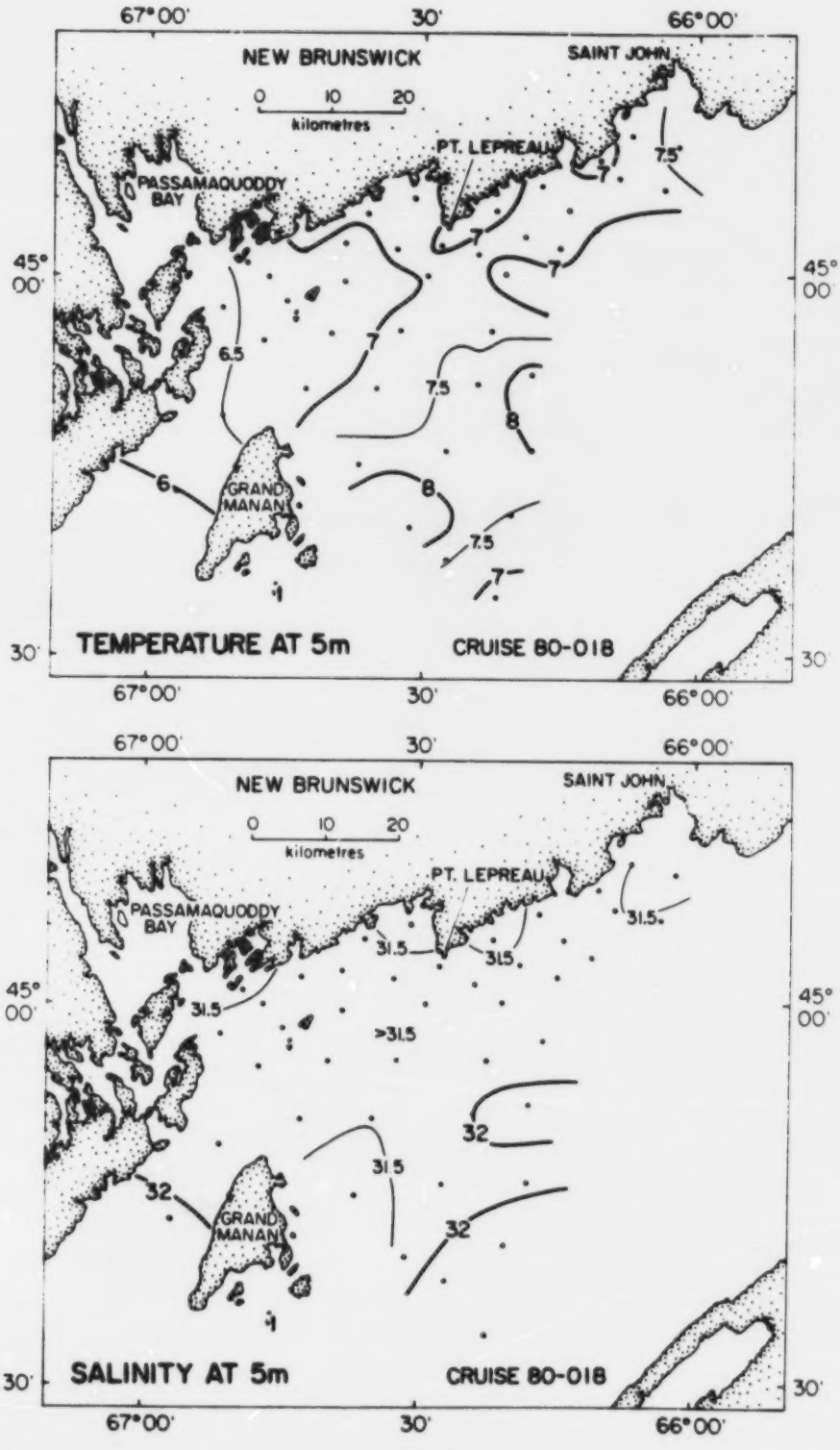

Figure 18

Horizontal sections of temperature and salinity at a depth of 5 m cruise 80-018.

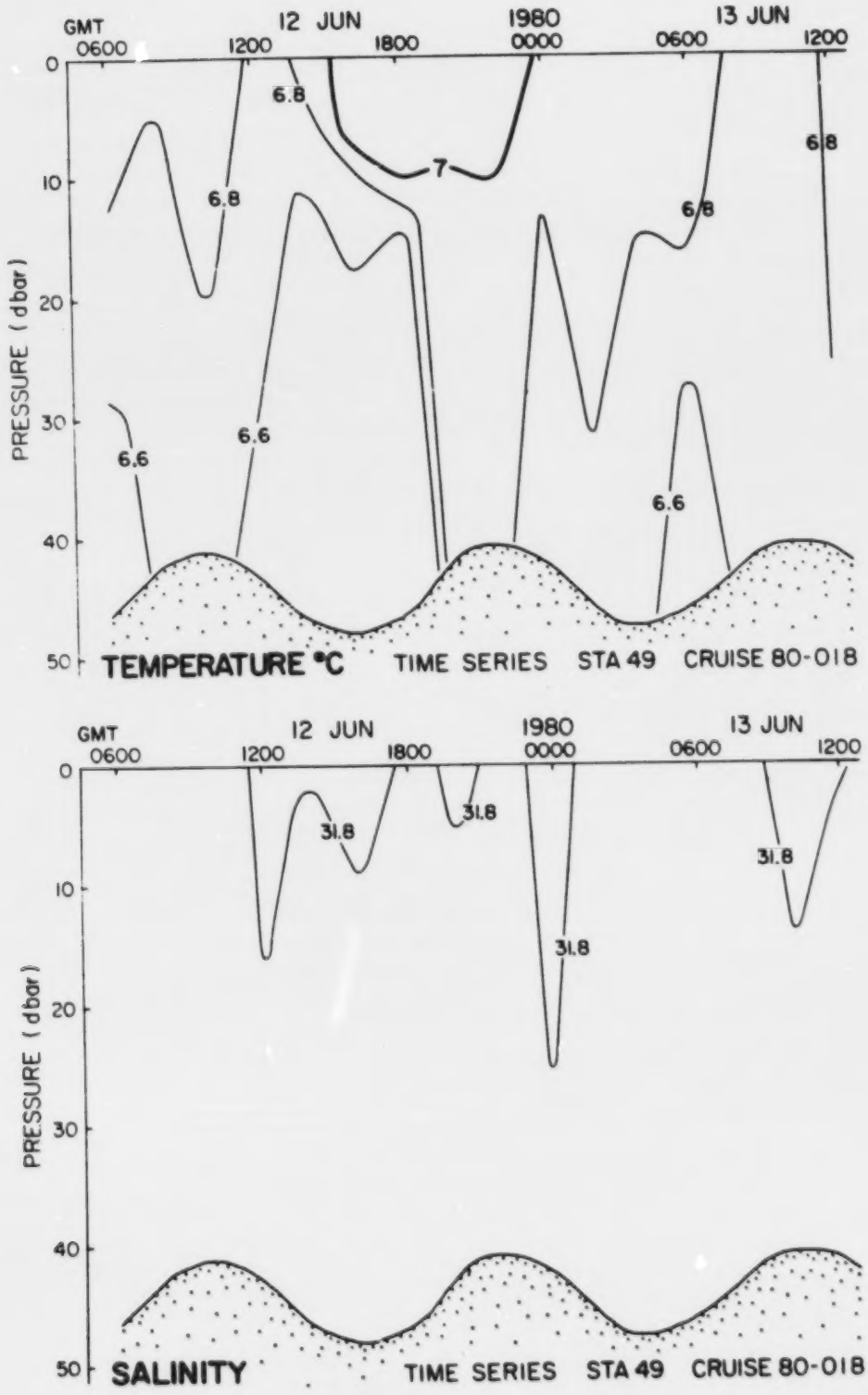

Figure 19

Time series contour plots of temperature and salinity from the anchor station (station 49) near the cooling water outfall cruise 80-018.

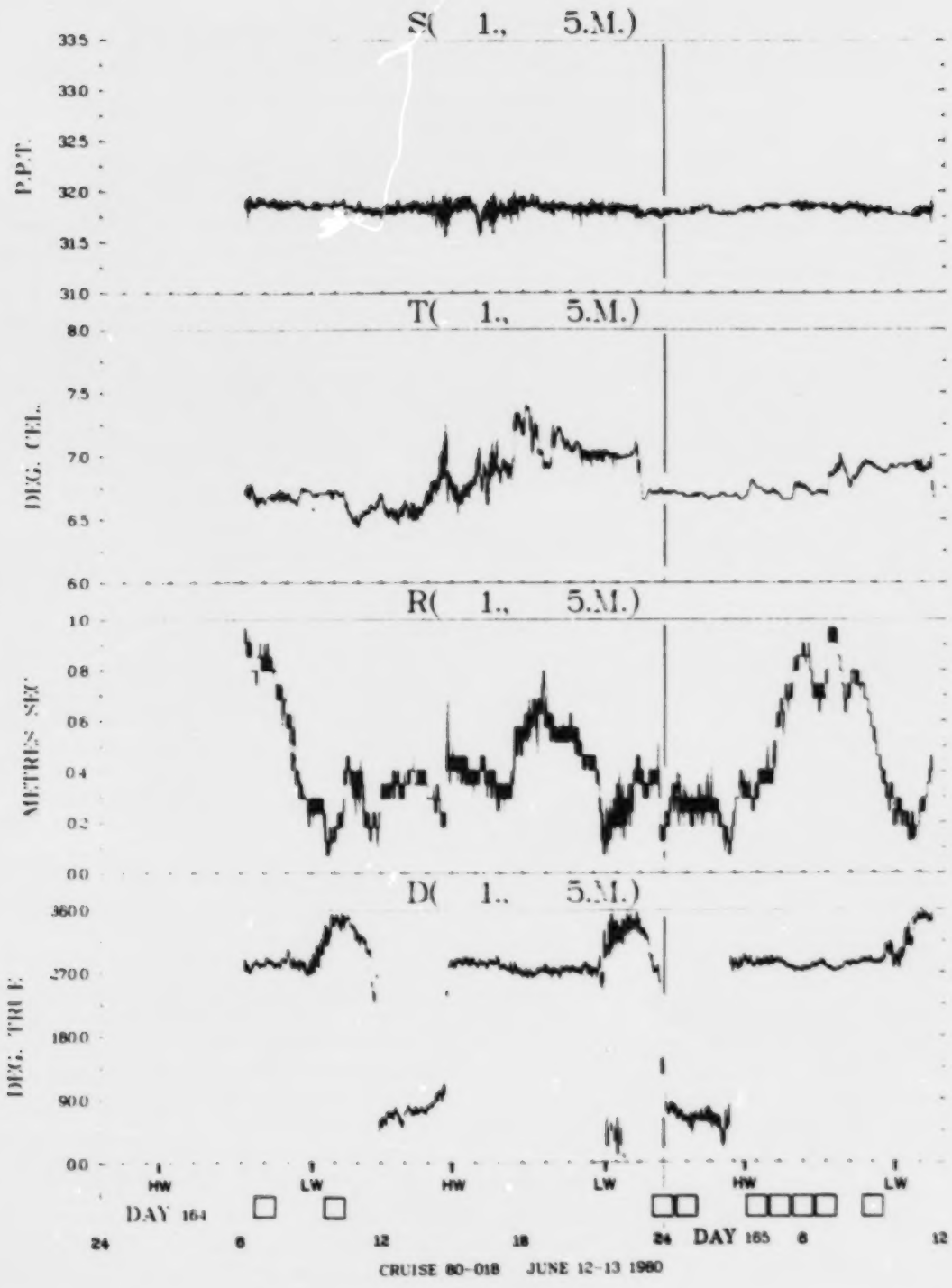

Figure 20

Current meter observations at a depth of 5 m at station 49 during cruise 80-018, showing times of high and low water at St. John. Squares indicate the time of release of surface drifters which were recovered. See text for explanation of possible errors in current direction.

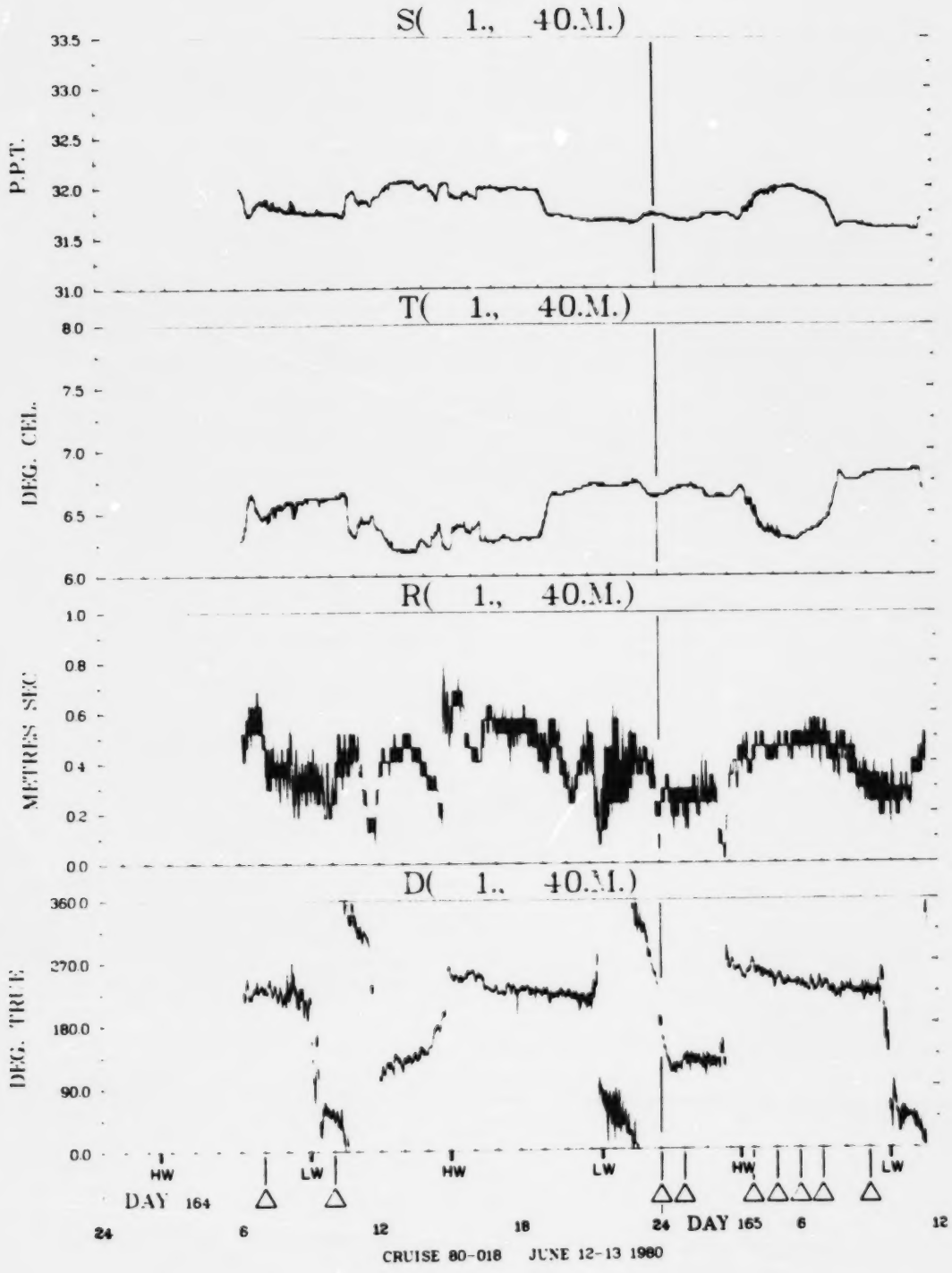

Figure 21

Current meter observations of a depth of 40 m at station 49 during cruise 80-018, showing times of high and low water at St. John. Triangles indicate the time of release of bottom drifters which were recovered.

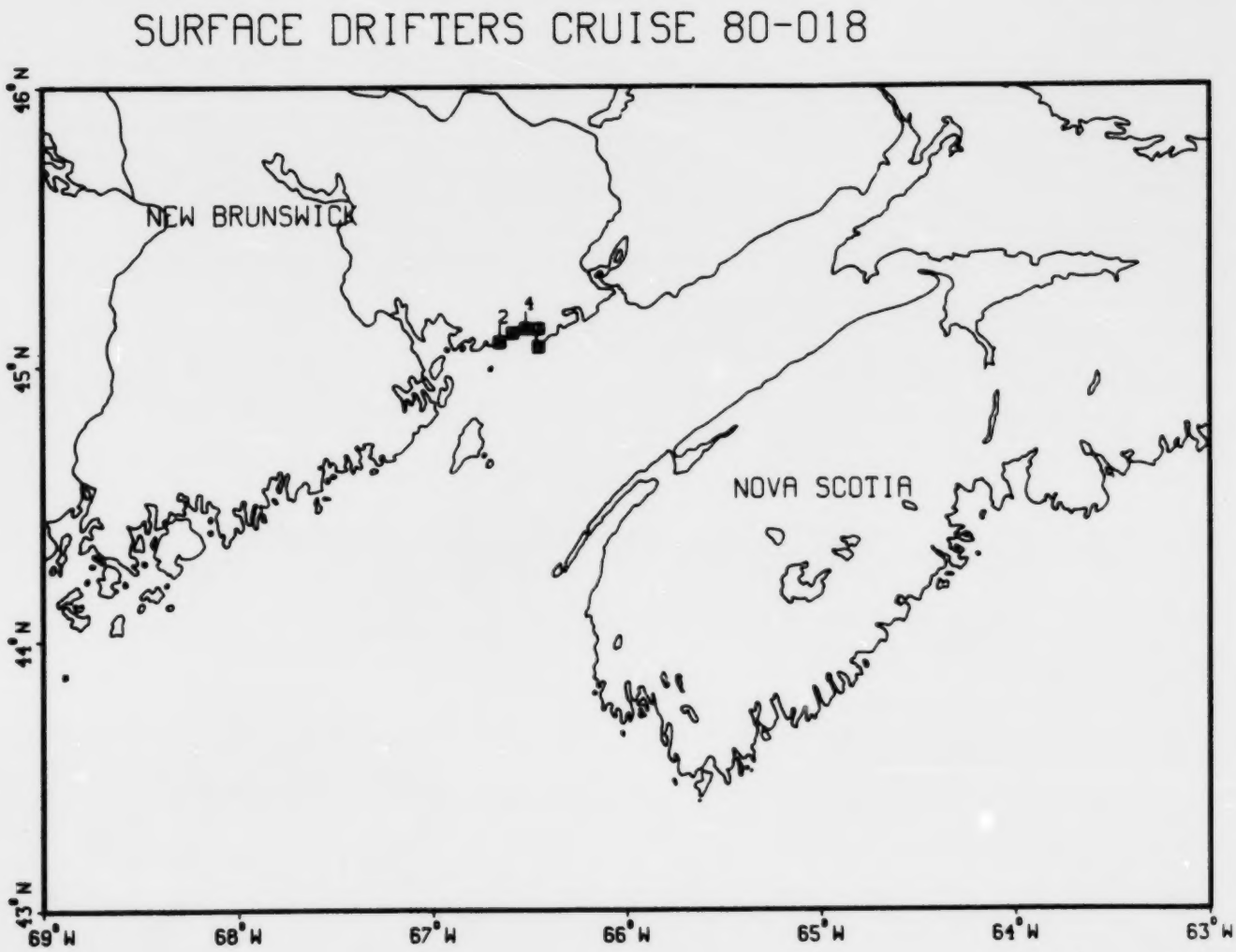

Figure 22

Chart showing location of returned surface drifters released during cruise 80-018. Numbers indicate a multiple return.

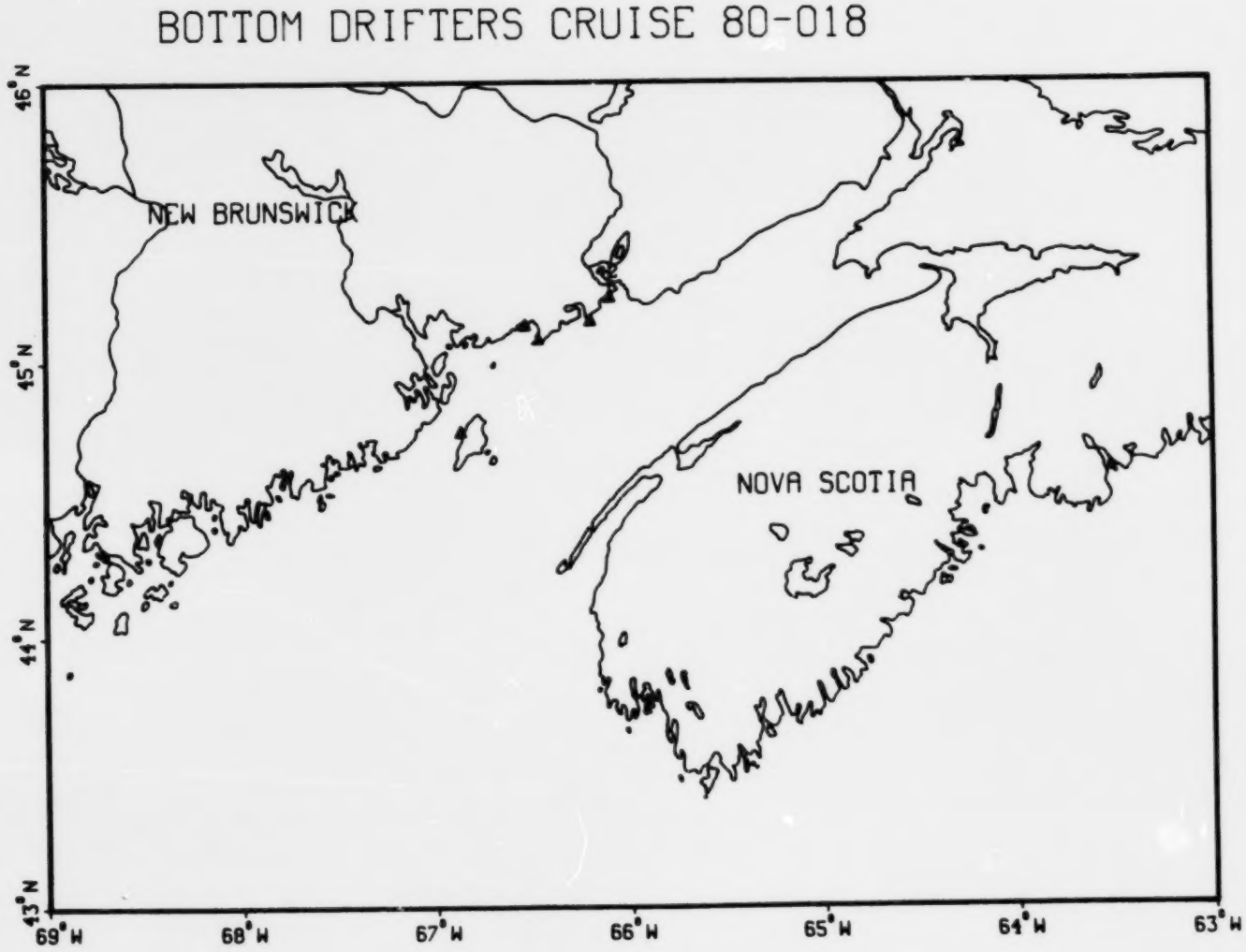

Figure 23

Chart showing location of returned bottom drifters released during cruise 80-018. Numbers indicate a multiple return.

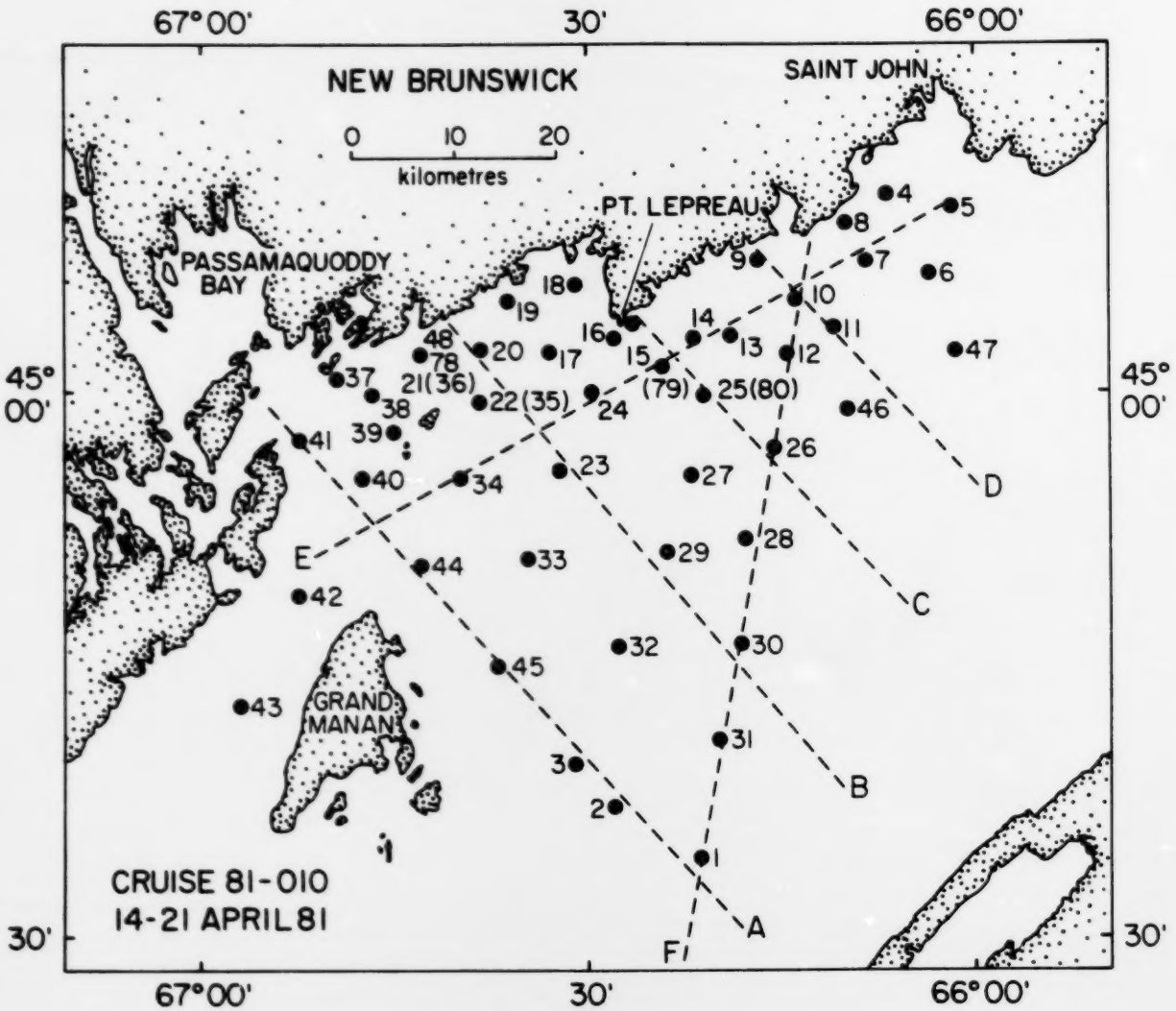

Figure 24

Stations occupied during cruise 81-010 showing locations of vertical sections.

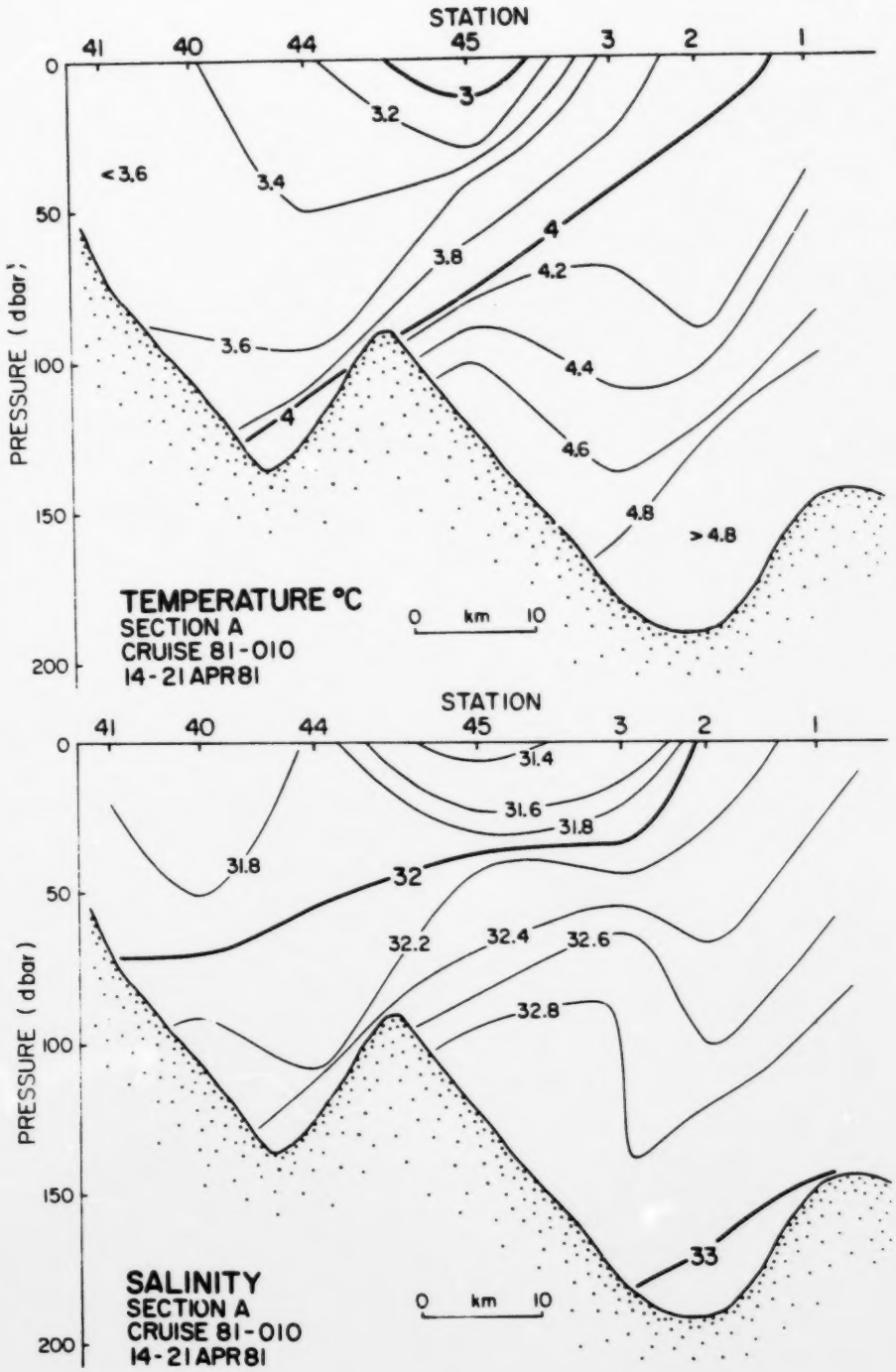

Figure 25

Vertical sections of temperature and salinity for section A cruise 81-010.

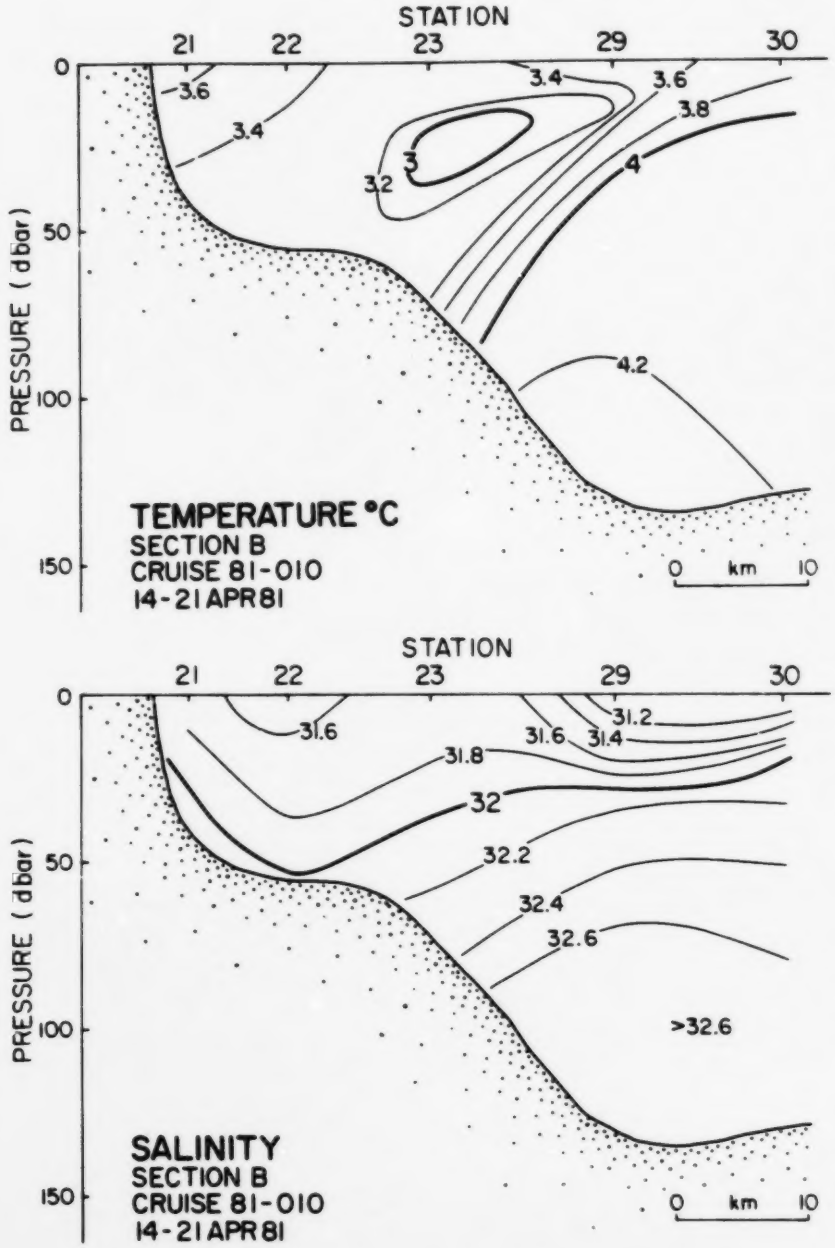

Figure 26

Vertical sections of temperature and salinity for section B cruise 81-010.

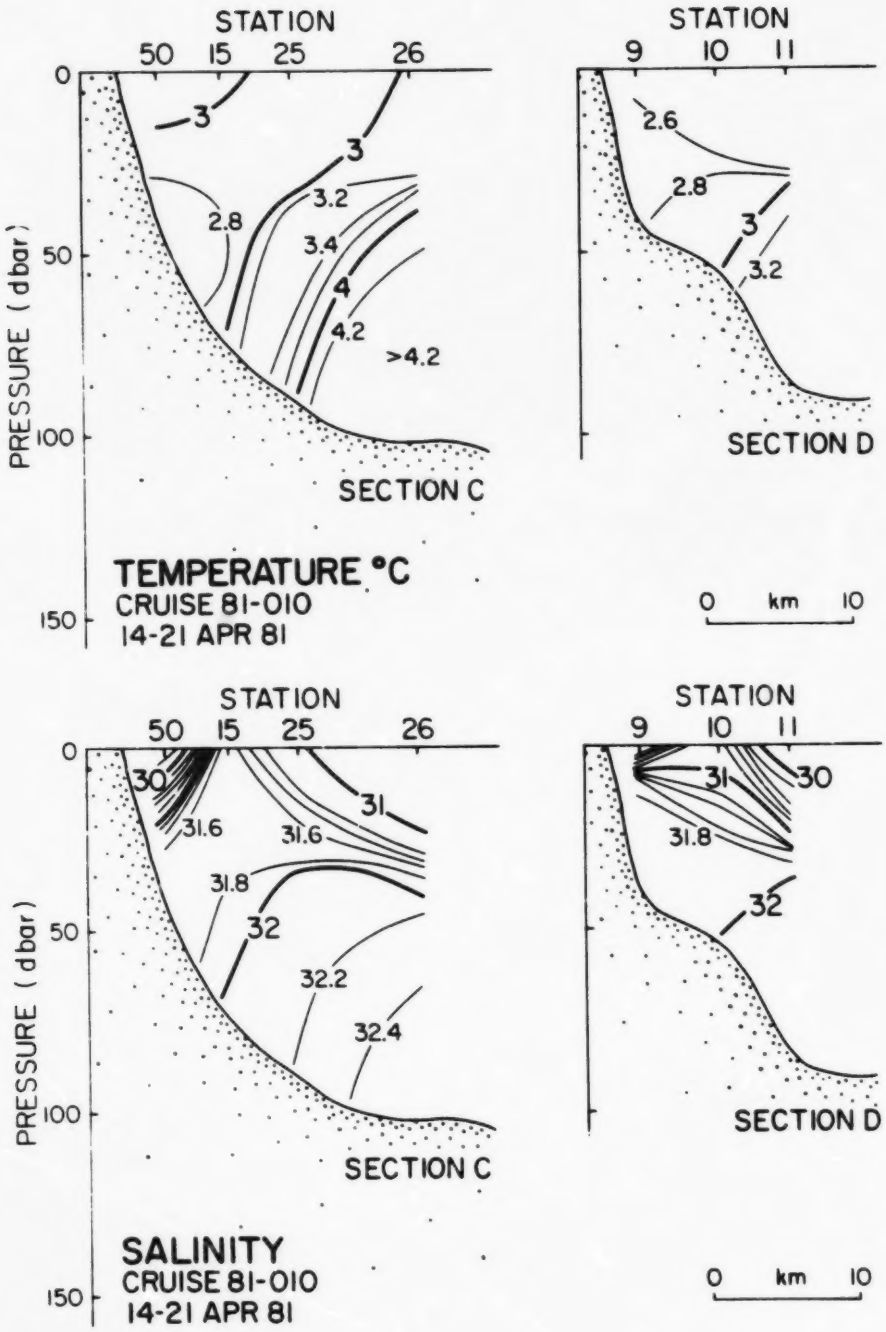

Figure 27

Vertical sections of temperature and salinity for sections C & D cruise 81-010.

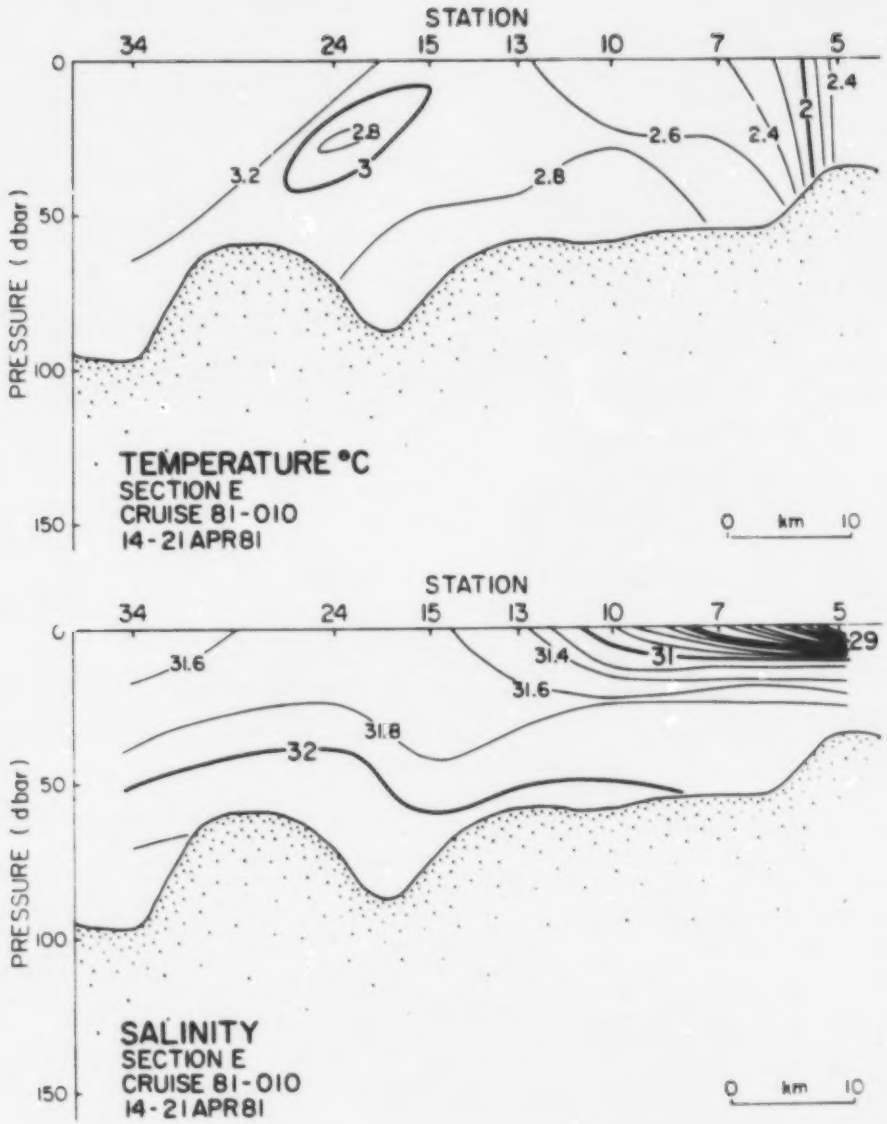

Figure 28

Vertical sections of temperature and salinity for section E cruise 81-010.

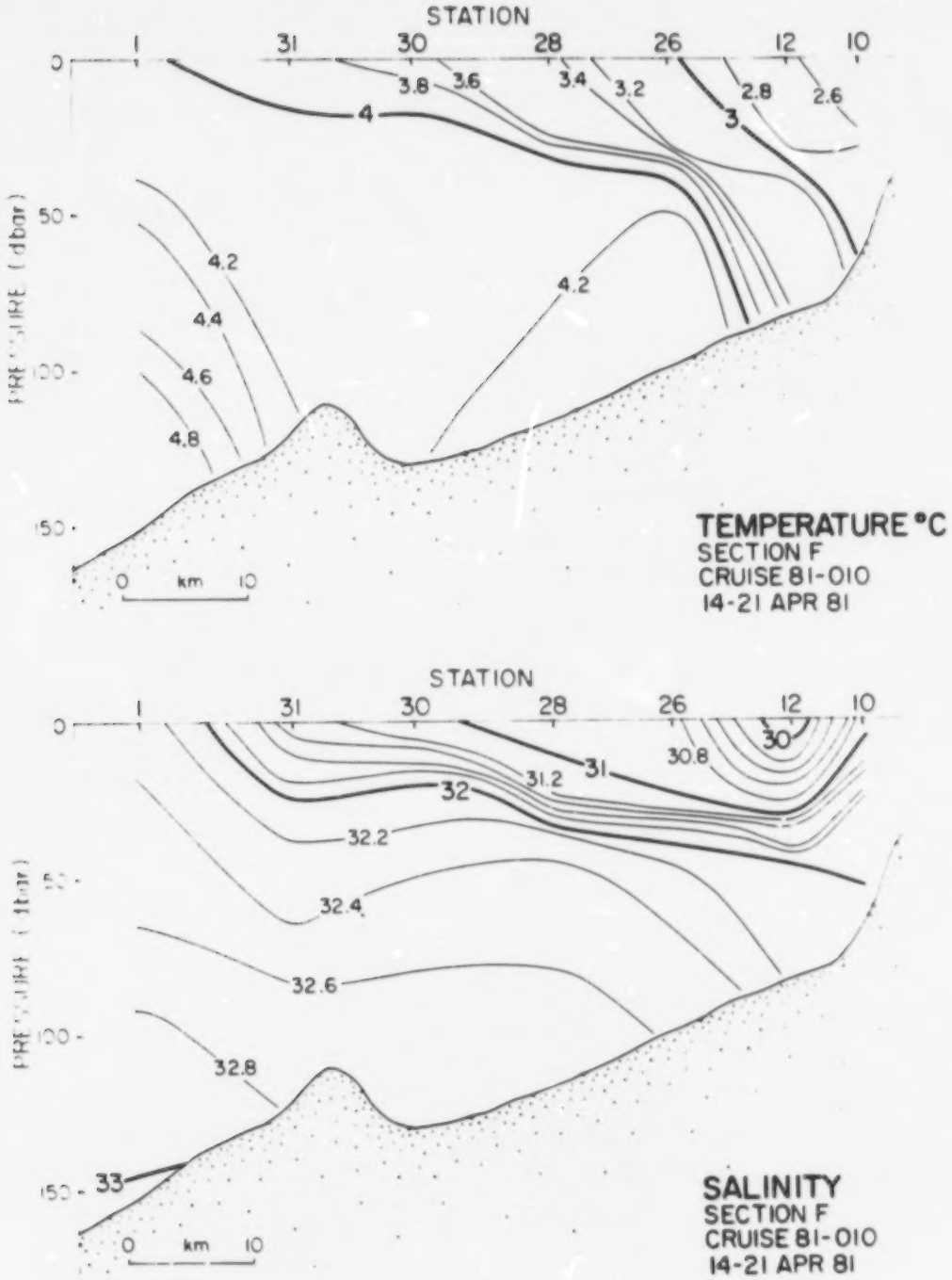

Figure 29

Vertical sections of temperature and salinity for section F cruise 81-010.

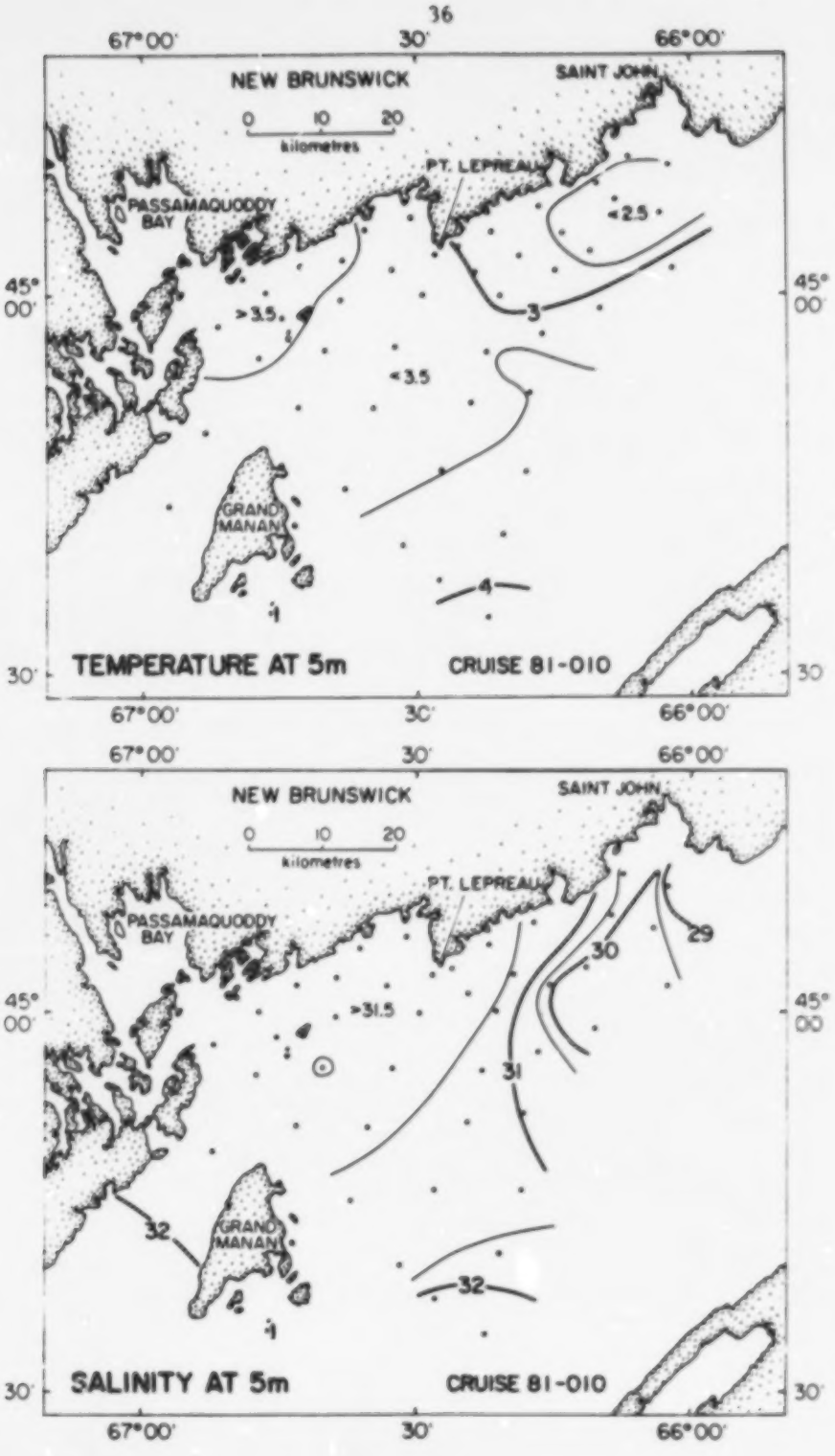

Figure 30

Horizontal sections of temperature and salinity at a depth of 5 m cruise 81-010.

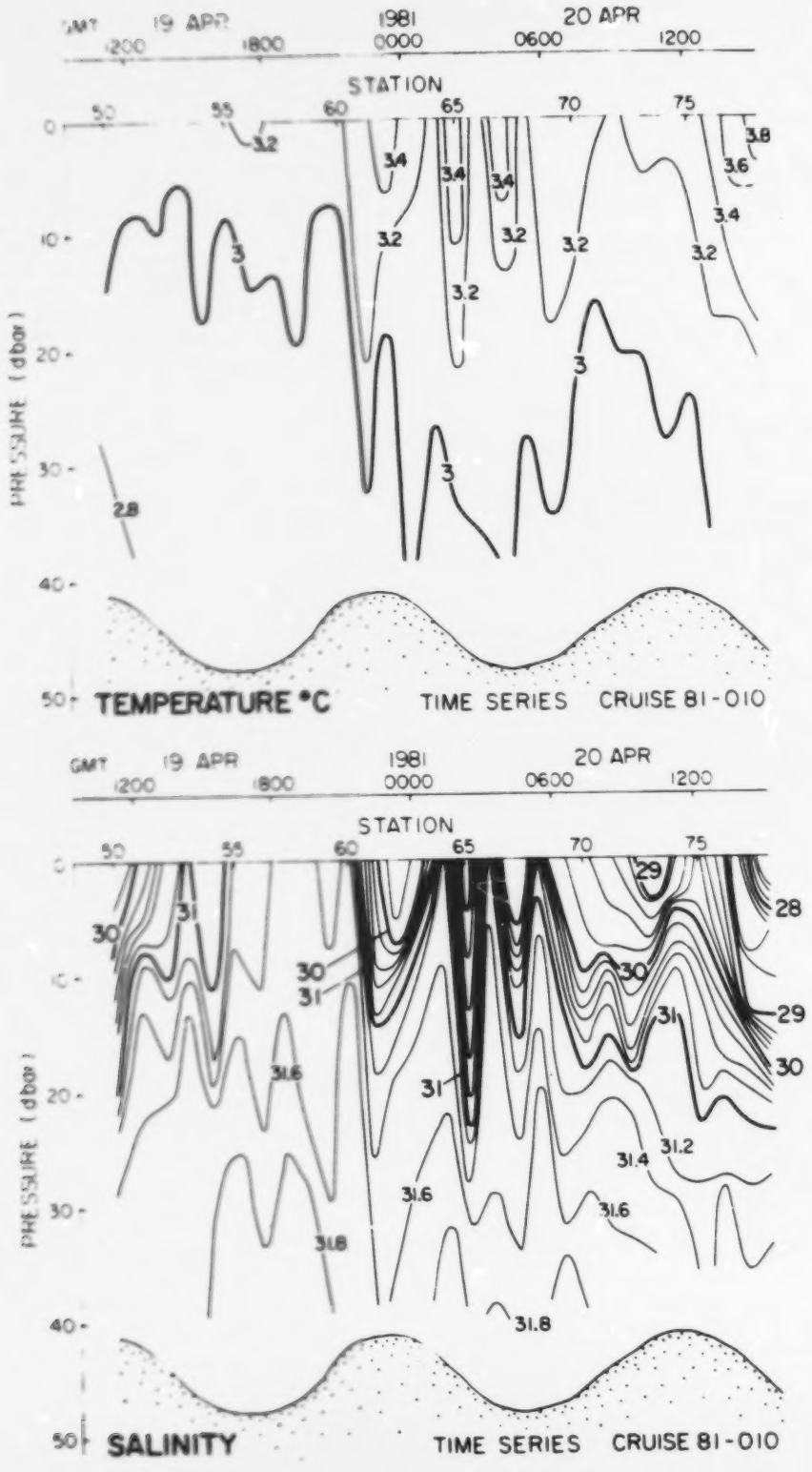

Figure 31

Time series contour plots of temperature and salinity at the anchor station cruise 81-010.

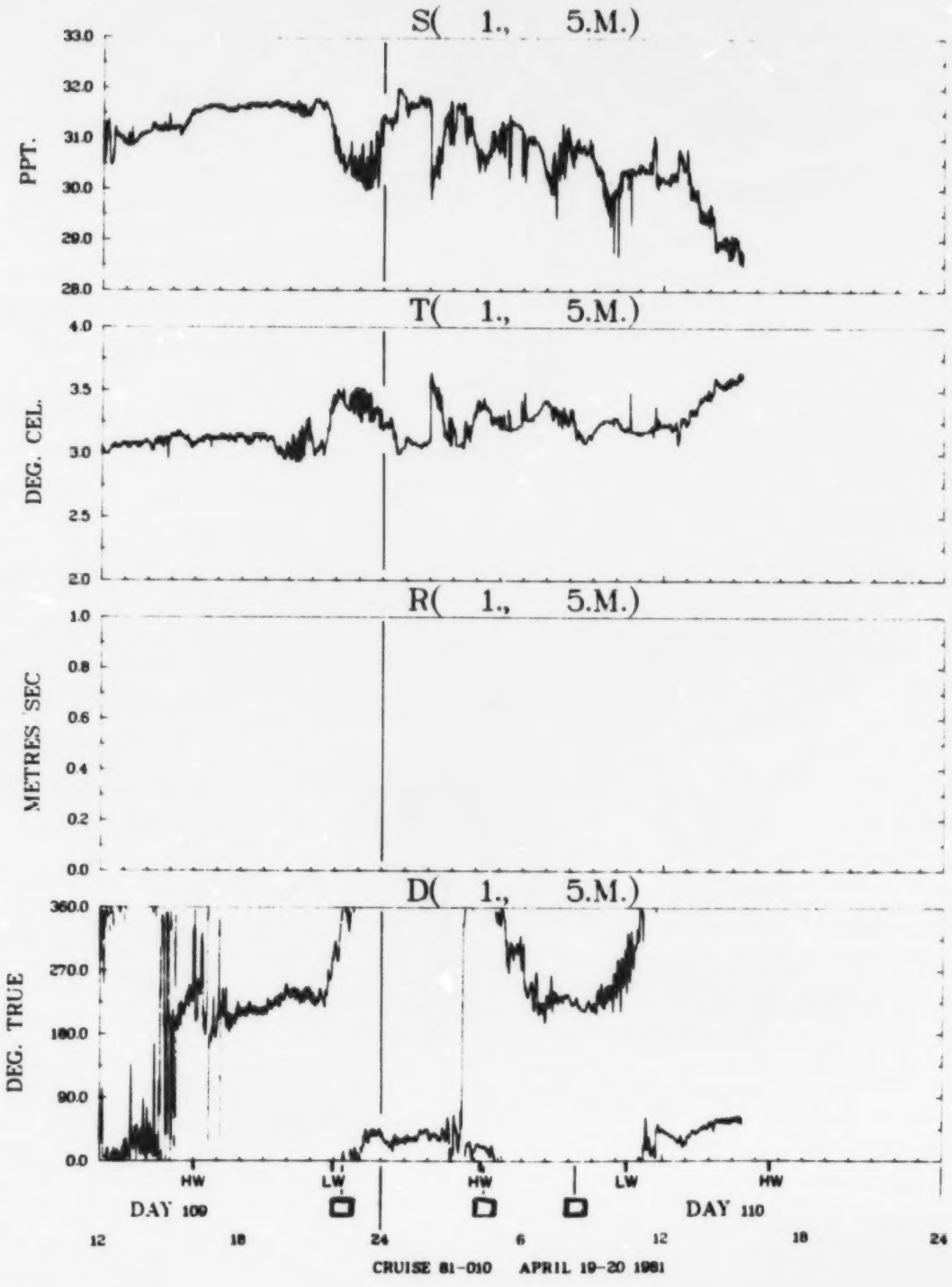

Figure 32

Current meter observations at a depth of 5 m at the anchor station cruise 81-010, showing times of high and low water at St. John. Squares indicate the time of release of recovered surface drifters. See text for explanation of possible errors in current direction.

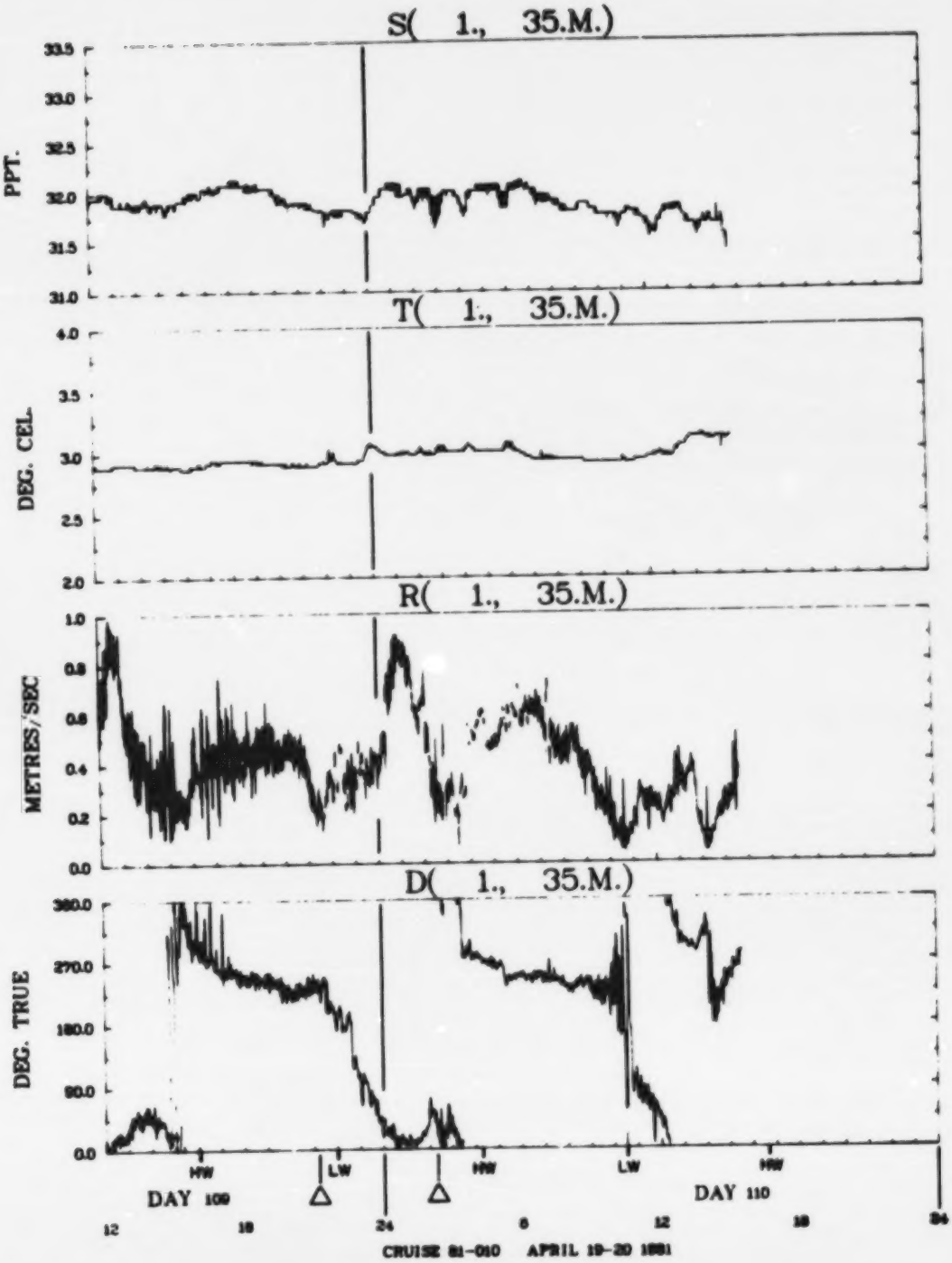

Figure 33

Current meter observations at a depth of 35 m at the anchor station cruise 81-010, showing times of high and low water at St. John. Triangles indicate the time of release of bottom drifters which were recovered.

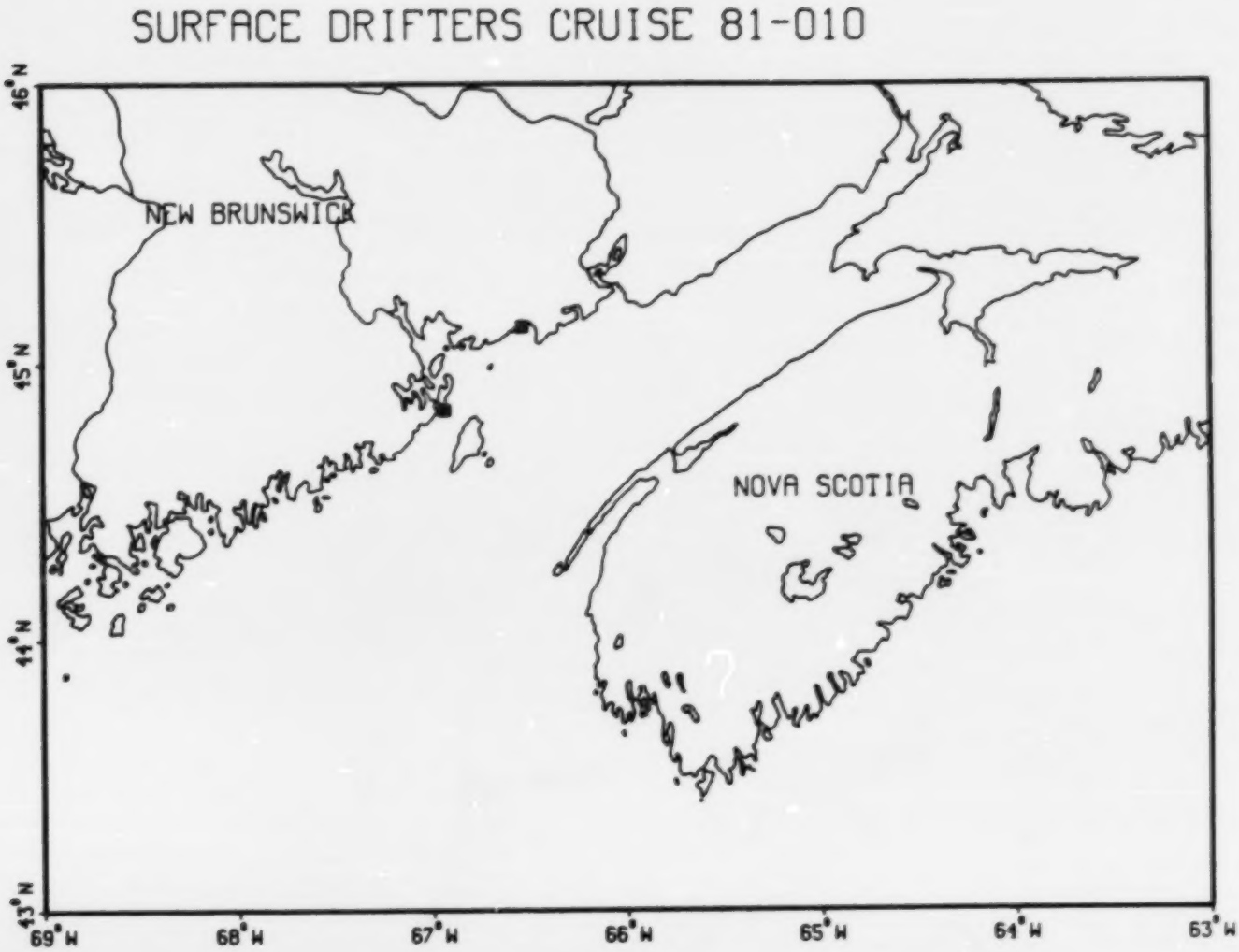

Figure 34

Chart showing location of returned surface drifters cruise 81-010. One drifter recovered beyond bounds of chart, see text.

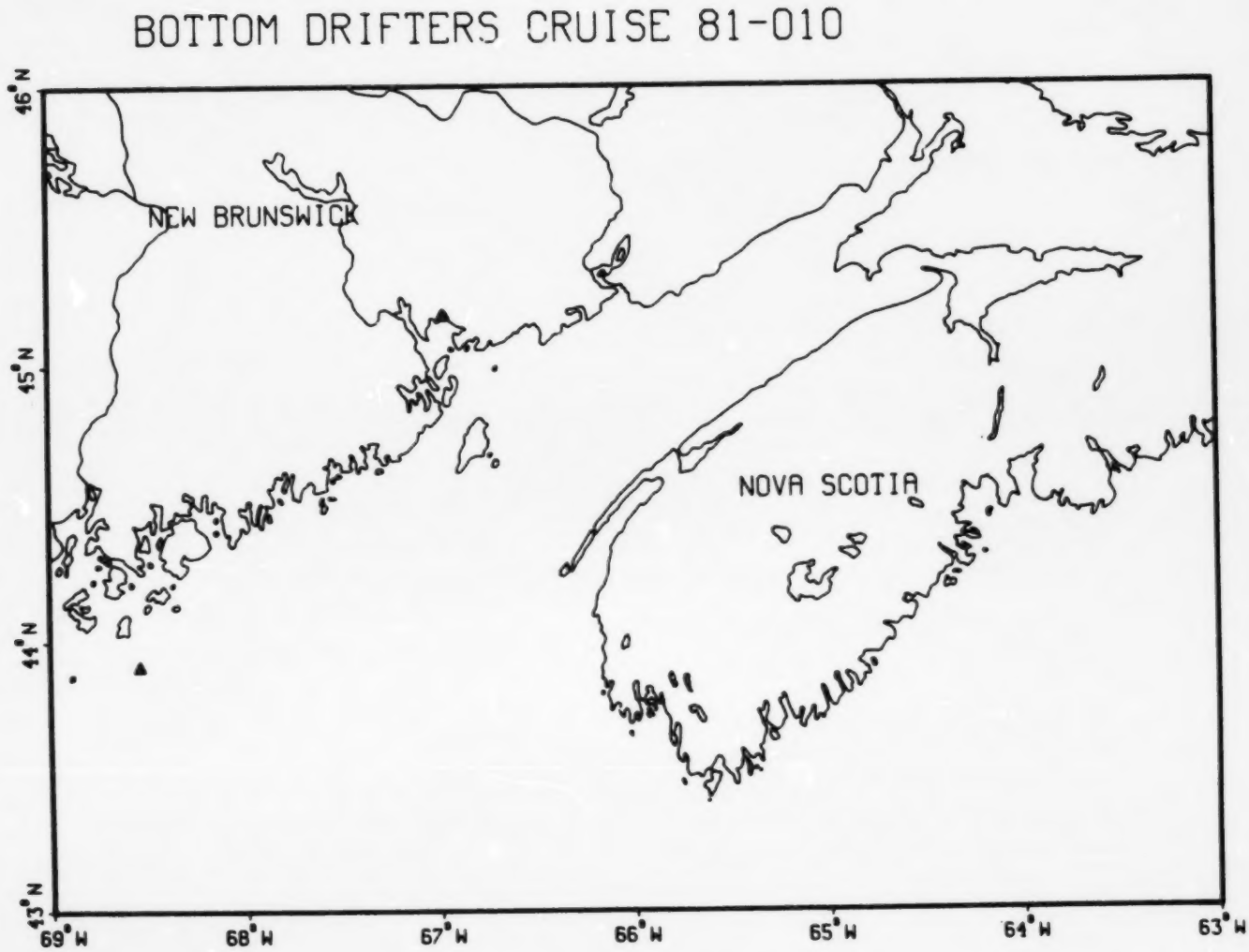

Figure 35

Chart showing location of returned bottom drifters cruise 81-010.